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GREEN SCHOOL SERIES

The Green Action Guide

A Manual for Planning and Managing Environmental Improvement Projects

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CEE

Centre for Environment Education, Ahmedabad

A Publication Supported by Ministry of Human Resource Development, Government of India

The Green Action Guide

A Manual for Planning and Managing Environmental Improvement Projects

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For teachers, eco-club organizers
and leaders of action groups

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Centre for Environment Education, Ahmedabad
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Centre for Environment Education(CEE) is a national institute of excellence for Environmental Education supported by the Ministry of Environment and Forests, Government of India and affiliated to the Nehru Foundation for Development. The main objective of CEE is to create environmental awareness among children, youth, decision makers and the general community. CEE develops innovative programmes and materials and field tests them for their validity and effectiveness. The aim is to provide models that could be easily replicable to suit local conditions.

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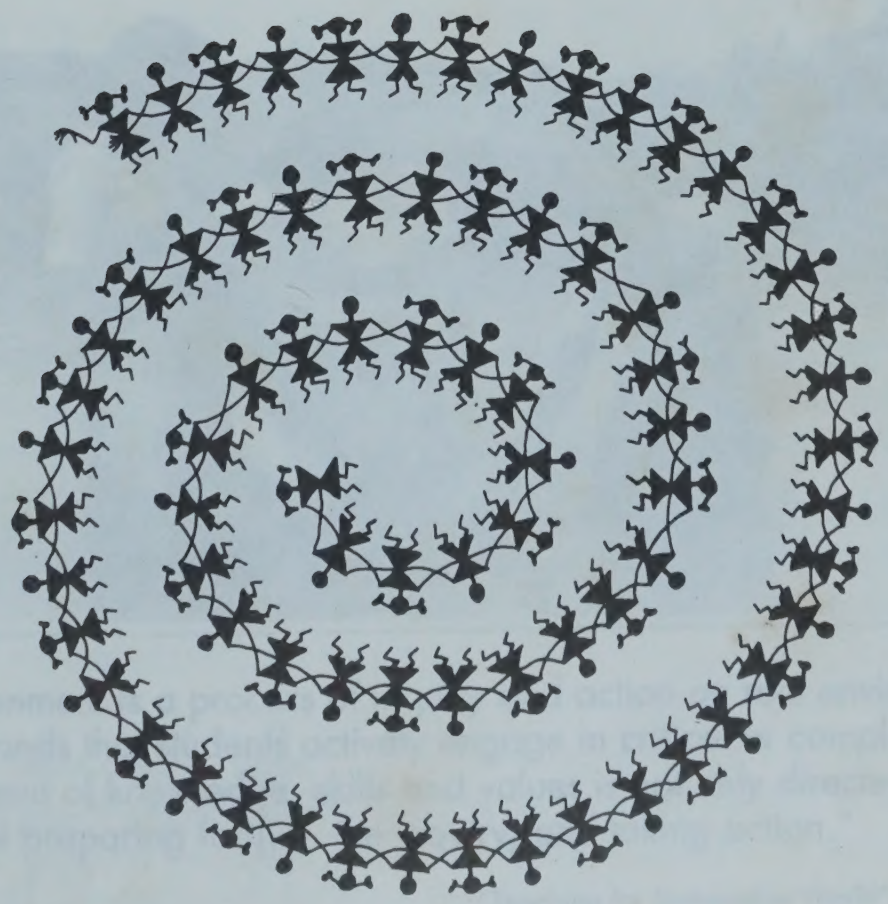


ENVIRONMENTAL ACTION PROJECTS

Empowering Children to Improve the Environment

The ultimate goal of environment education is action—action to improve the environment, prevent its degradation, and sustain its well being. And for children, action itself can become a powerful way of learning about the environment, because it helps them realize that their actions can make a difference, and it fosters a sense of responsibility for their immediate environment.

Children can be encouraged to take up such action projects in their homes, neighbourhoods and schools. The emphasis needs to be on direct action, which will show tangible results that will begin to manifest themselves in a fairly short time span. The sense of action and achievement which will result from undertaking these projects will excite and motivate children and lay a foundation for a lasting commitment to the environment.

Children need to realize through these action projects that, irrespective of whether they live in cities or villages, in the plains or on hill slopes, on farms or in tenements, there is something that they themselves can do to improve the environment. The stress should be on getting children to act, and on reinforcing the message that each one of them can affect the environment through their actions. It is important that the children realize the impact of what they are doing, not only on their immediate environment, but also its linkages with, and implications for, the macro-environment. It is equally important that they realize that there are many traditional practices which are environmentally sound, but are being overlooked or forgotten today. Such projects may be a good way of getting children to integrate traditional wisdom with school learning. Through such projects, children learn how to put theory and information learnt in school to practical use in improving the immediate environment.

This manual presents some ideas for projects that teachers can carry out with their students.

Photo courtesy: CEE

"Education for the environment is a process of inquiry and action on real environmental issues. Such an enquiry process demands that students actively engage in critical or complex thinking about real problems. The development of knowledge, skills and values is not only directed towards action but emerges in the context of preparing for (i.e. the inquiry) and taking action."

"Teaching for Sustainable World": UNESCO-UNEP IEEP, 1996

Environmental Action Projects: What, Why, How ...

What are Environmental Action Projects?

Environmental action projects are projects that:

- Involve those activities through which students work to tackle an environmental problem or issue, or to improve their immediate environment.
- May be relatively simple—e.g., starting a campaign to keep the school clean, or complex—e.g., involving a neighbourhood community in a garbage management project.
- May be undertaken within the formal curricular framework, or as an extra or co-curricular activity.

Why Action Projects?

Action projects:

- Provide a valuable opportunity to channelize the youthful energy of students, and their natural urge to understand, debate and solve important real-life issues.
- Involve activities in the real world. Students deal with real situations and people rather than textbooks, ensuring a relevant educational experience.
- May be connected to the curriculum to provide students a chance to discover the interdisciplinary linkages. They help build an understanding of place, time, change and relationships in real phenomena and situations.
- Build important skills that apply to all aspects of life, that are difficult to acquire from textbooks, such as listening, talking, discussing, analyzing, and communicating, identifying problems as well as solutions. Most important, students learn to plan and take corrective action. Creative and critical thinking, problem solving, decision-making, team work, negotiation and conflict resolution are built into the experience.
- Stress cooperation and team work, which helps to cater to different levels and abilities of students, providing opportunities for each to contribute their strengths and develop leadership skills and cooperative learning.
- Help students develop self-reliance and responsibility, and understand the importance of planning and systematic organization of work plans.
- Empower students. The opportunity to take part in a process with tangible results provides them a sense of control over issues in their own lives, a better understanding of the multiple dimensions of issues, and a confidence that they are able to make a positive difference.
- Help create role models. Students who have participated in such projects set examples for what could be accomplished. The students' enthusiasm and experiences are passed on to others who may also be inspired to take on such endeavours.

How are Action Projects Done?

Good planning increases the chances of success of any project. The planning process itself is a valuable educational experience for the students. Wherever possible, it is important that students be involved in this process right from the beginning, including the critical decision on what project to take up, thereby creating a sense of ownership and active involvement from the start.

Selecting a Project

- The first step requires the teacher to make a list of possible projects. Remember, an action project need not always address a problem or an issue. Environmental improvement activities such as creating nesting sites or flower gardens are equally productive projects, as they help students acquire important skills such as planning, observation and systematic implementation. They also exhibit visible results which serve to encourage the students involved and attract the attention and interest of other students.

- Options for action projects are then presented to the students. For example, in a particular year the options may include greening the school grounds, stopping water waste in school, or garbage management in school.

- Students may discuss the possibilities and collectively decide which project interests them. While the students' interest in the project is important, it may be necessary (for the teacher) to guide the discussion in terms of the limiting factors which may determine the feasibility of the project, such as availability of time, ability of students to perform the tasks involved, other resources—financial, material and human—required for the activities, etc.

- Discuss and choose a project in the light of the following guidelines which may help to narrow down the choices and lead to a decision.

Practical Aspects

Support

Will the project have the support of the school authorities and/or the relevant local authorities or community leaders? Determine this factor before placing the options before the students. Students may be very demoralized if, after having detailed the action plan, they discover that the authorities are not willing to give the necessary permission or lend support.

Clear Focus

Is the project focused? Are the goals and objectives clear? In this situation, there is a strong tendency to take on too much, which may lead to a great deal of activity, but very little in terms of concrete results. Help students to clarify the objectives of the project, and focus on "doable" tasks.

Time

Is it possible to complete the project within the time frame available—e.g. a school year, one academic term, 30 classroom periods, etc. It is always useful to allot some extra time, as projects are rarely completed within the stipulated time frame.

Complexity

Does the project involve a variety of issues, resources, inputs and actors? A very complicated project is difficult to complete. If students are keen to take on a large project, try to identify the most feasible aspects of the project and initiate activities accordingly.

Results

As students will naturally want to see outcomes of their activity, determine whether the project will demonstrate some concrete results within the planned time frame. It should be kept in view that some projects, though very exciting, may not show obvious results, which may cause feelings of disappointment or frustration among students.

Dependence on Other Resources

Some projects may require additional financial or human resources or information. Determine whether these will be available before deciding on a project.

Educational Aspects

- Does the project integrate an educational process that involves and encourages experimentation, interest, choice, a sense of anticipation, and of course, activity on the part of students?
- Will the project lead to creating a greater awareness among students about their environment and its diverse aspects? Does it involve students in undertaking activities which require exploring beyond classrooms and textbooks, and considering the broader context of their surroundings and the roles of different people?
- Will the project help to develop important skills through which they would be able to find out more about their world? Two kinds of skills should be considered: thinking or processing skills, which relate to how we use our minds to work out issues. For example, will the project involve students in observing, comparing, measuring, classifying, inferring from records and interpreting data? Practical skills involve students in handling materials, finding out how they behave and what they can do.
- Will involvement in the project ultimately lead to change in attitudes among the students? For example, would the process help to create a sense of respect for all living things, a feeling of mutual respect for each other, and above all, a sense of responsibility as well as confidence in the students' own ability to be able to "make a difference"?
- Is the project conducive to group work, and will it serve to enhance team spirit? It is important that all the students involved are provided ample opportunity to participate actively as this would teach the value of cooperation, patience and mutual understanding.
- Could the process, as well as the learnings from the project, be used to link, highlight or reinforce the contents of curriculum?

Environmental Aspects

- Is the project likely to make a positive impact on the environment? Would the students and others be able to perceive a positive difference as an outcome of the project?
- Does the project address a real issue? Students should carry out an initial survey which would help them to decide priority issues. For example, a school which already has a well-tended garden/grounds may not need to take up a greening project; a school in which the majority of the students walk or use public transportation would not find practical use for a campaign against private vehicles.

Developing an Action Plan

Once students have selected the project, they should develop an action plan for carrying it out. One idea would be to begin with the question: "What do we hope to achieve by pursuing this project?"

And to work backwards through possible steps that would help to reach the objective. This must be incorporated into the time frame assigned for the project. For example, if the project is to be completed by the end of the school year in March, the students could plan a calendar of activities working backwards to the start of the academic year in June-July. Or if the students have 30 weeks for example, they could plan the activities from week 1 to week 30. They must, with the assistance of the teacher, plan the tasks to be carried out at each stage and identify who will be responsible for what and when. The class could work in four or five groups, each group having a specified set of tasks to perform.

It is important to tell the students that things may not go precisely as planned, thus the plan must be designed with enough in-built flexibility to absorb or accommodate unexpected developments. Students could also list the other resources required to carry out the project and begin to identify possible sources. For example, if a tree plantation project is planned, they should identify where to obtain saplings, e.g., forest department, private nursery, etc. If they plan to make feeding trays and nesting homes for birds, they need the help of the school workshop or a carpenter, while they may need to enlist the cooperation of the Municipal Authorities for a Garbage Management Project. If they require funds for carrying out the project, they could list possible sources e.g., contribution from school or students, corporate sponsorship, etc.

They may also think of ways they could inform the rest of the school or community about the project, and encourage them to follow its progress. This could be accomplished through announcements at the assembly, creating a notice board for the project, organizing community meetings, etc. Spread of information about the project on a wider scale is important, especially if at some stage the project would require involvement of other members of the school or community, as well as to create a climate of support for the project.

Once the project has been put into action, the action plan developed by the students would help them monitor the progress and verify that the project is proceeding as planned—in terms of objectives to be achieved and the time schedule. Necessary modifications could be made after taking stock of the situation at each stage.

Monitoring the Progress

Besides the importance of being able to show what the project has achieved, it is also recommended to maintain a record of the progress of the project, not only for the group involved, but also to serve as a guide for other groups taking up similar projects. It would be beneficial if students kept a record, individually or in groups, of the progress of the project, including weekly activities, setbacks if any, and unexpected findings or experiences. Their own reactions and feelings about the activities, e.g. if the groups disagreed on a point, if an activity did not have full cooperation of the group, etc., would also be useful. If it is a project such as greening, they could record observations about the progress of plantation—for example, how many days after sowing did the first sprouts appear; how many centimeters of growth of a sapling in one month, etc.

Assessing the Project

As the project nears completion, it is important for the students to assess the project. They could discuss how successfully or otherwise the project accomplished the objectives stated at the outset. They could also conduct surveys to determine how others in the school and community perceived and assessed the project. Analyzing which aspects of the project worked well and which of them did not, as well as determining reasons for both would be a very useful exercise. They need to consider what changes or improvements they would suggest to another group of students who may decide to take up a similar project.

It is also important for the students to assess the impact of the project on themselves. Students should be encouraged to discuss their own experiences and feelings during the course of the project. What did they learn from the project, not just in terms of information, but in terms of skills, interpersonal relations, communication, personal attitudes, and impact on their own behaviour, and those with whom they interacted during the project. What did they like most, and least, about the experience? Would they like to take up an action project again? If so, what would they do differently? Above all, they need to think about how the project initiated by them could be sustained - for example how could they ensure that the trees planted by them continue to be nurtured, or how their achievement of a "Clean School" would endure.

Laying the Foundation for Lifelong Learning

Initiated in a climate of participation, and appropriately planned and systematically carried out, environmental action projects could have a high success rate. The outcomes of such projects are much wider and deeper than achievement of the short-term objectives—e.g. planting and growing 50 trees; identifying leaking taps to be repaired/shut; ensuring that all biodegradable school waste is deposited into a compost pit, etc. Involvement in the first-hand, real experiences of projects offers students an opportunity to learn in, from and through the environment. This can plant the seeds of a responsible attitude towards the environment and a sense of personal responsibility for a better future; and above all, create the confidence in students that they can make a difference.

Photo: Madhavi Joshi

A GREEN FUTURE

- One full-grown tree neutralizes the carbon dioxide output of one person.
- The oxygen produced from a vegetated area of 30 - 40 m^2 is sufficient for one person per day.
- A full-grown tree is able to absorb the pollution generated by a car running continuously for 25,000 km.
- If one hectare of land is not under green cover, 24 kg of fertile top soil is removed by wind and water every year.
- Trees and plants are able to reduce the temperature of an area by as much as 10°C.
- Over 25 per cent of our medicines are derived from plants.
- Vegetation absorbs noise. Trees are able to reduce the noise level by about six to eight decibels for every 30 m of tree cover.
- Trees are the basis of many of our industries, for instance, the paper industry.
- Greenery is aesthetically pleasing.
- The importance of greening goes beyond the planting of trees or plants or grass. The real success of such a programme lies in how much of what is planted actually survives and thrives.

Photo: Madhavi Joshi

There are innumerable reasons to green. People may wonder how they could plant trees if they have no space, but greening is not just about trees. One could plant shrubs, herbs, creepers, grass, a kitchen garden ... a variety of plants. They will all, whatever their size or shape, offer the advantages mentioned above.

How Do Plants Help?

Soil Protection

Under the impact of wind and water, loose soil is continuously blown or washed away. This precious topsoil supports plants, and therefore life. Roots of plants hold the soil, thereby preventing its erosion.

Water Savers

Vegetative cover also helps in water conservation. When rain falls, water that is not absorbed will inevitably flow off. If the soil is covered by vegetation, the plants and leaf litter slow down the flow of the water. When water is held on the ground for a longer period of time, more of it percolates into the ground and is stored there for us to use as ground water. Also as the roots grow, they create paths into the soil, through which water easily percolates downwards.

Air Coolers

A mature tree with dense canopy is able to transpire upto 340-450 litres of water on a summer day, which cools and refreshes the air. Transpiration also helps trees to clear the air of pollutants, as the increased humidity around the branches of a tree attracts airborne pollutants which settle upon the leaves.

Rain Makers

Plants and trees play an important role in the water cycle. Plants absorb water from the ground, of which a percentage is transpired into the atmosphere, thereby contributing to cloud formation and rain in the area.

Pollution Checkers

Trees also help to remove particulate matter, such as dust, smoke and fumes, from the air by trapping them on their leaves, branches and stems. This process is enhanced by the presence of fine hairs on the leaves. The dirt particles are then washed to the ground during the next rain. Plants, especially trees, remove many other air pollutants.

Vegetation belts have a great value in noise control. Plants are efficient absorbers of noise, especially those of higher frequencies.

Home for Many

Trees attract birds and animals and bring life to an area. A single tree in the tropics is likely to have more than 1,000 different kinds of insects living on it at one time. A garden full of flowers and trees attracts many insects, birds and other animals such as squirrels, thus supporting a wide range of life forms.

Pollutant Traps

Type of cover	*Pollutant*	*Pollutants removed (tons/ acre/yr.)*
Forest	Sulphur Dioxide	0.16
Mixed Woodland	Carbon Monoxide	1.23
Mixed Woodland	Oxides of Nitrogen (NO_x)	0.2
Lime Trees	Dust	22.4
Grass	Dust	0.17

How to Green?

With so many advantages, obviously tree plantation, kitchen gardening and other greening projects are very popular.

Whichever kind of greening project you decide to take up, you will need to follow some basic steps:

1. Selection of site
2. Survey of area
   - soil conditions
   - water availability
   - protection needs
3. Studying the environmental conditions
   - temperature
   - rainfall
4. Species selection
5. Preparing the plot for planting
   - ploughing and tilling
   - manuring
6. Planning of plantation
7. Plantation
8. Protection
9. Maintenance

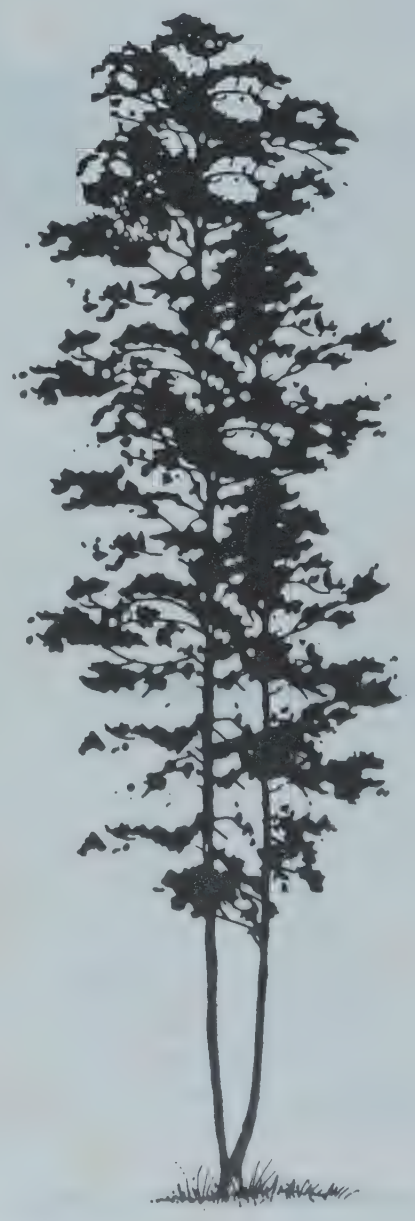
Step 1: Selection of Site

When choosing a site, the prime considerations should be whether the soil seems fertile enough to support plant growth; whether it is possible to protect the plantation from humans, animals etc.; and whether water will be conveniently available to the plantation.

There is no optimum size; whatever area is available may be used. However the size of the site would be a major factor in deciding what to plant.

Depending on the size and other conditions on the site, you may decide on planting a single tree or creating a flower, vegetable or medicinal plant garden, a fodder plantation, etc. If the site is large, then it may be divided into smaller plots and each plot managed separately by different groups of students. If it is small, students may share the work.

Having identified a possible area, necessary permission must be obtained to use the area for plantation. If the site is inside the school premises (either part of the grounds, or around the compound wall, or along a path inside the school), permission of the Principal would be necessary. If it is outside the school, prior permission from concerned authorities, such as the Panchayat, the Municipal Corporation, etc. should be taken.



If it is a public place such as a common vacant plot, permission to fence it should be obtained from the relevant authority. Fencing is essential so that the plants grown are protected from the danger of being eaten by animals or otherwise disturbed.

It would also be desirable to involve the community around the area, so that they are also part of the effort.

Step 2: Survey of the Area

It is important to study several factors on the selected site. This survey should include a study of soil and water availability. What to grow as well as where and how to grow, it will depend on these features of the site.

Soil

Soil is the layer of the earth on which the plant grows, and which supplies precious water and nutrients to the plant. It is a crucial factor in determining the type of plants that would be able to successfully grow at a particular place.

Investigating the Soil Type

Students may learn about the texture of the soil in the site by using any of the following methods:

Hand Texturing

Requirements: Soil sample, soil texture chart

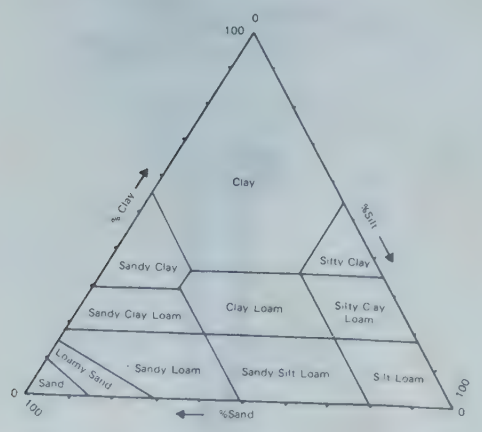
- Moisten soil sample until moisture glistens on the surface.
- Rub between fingers and assess grittiness, smoothness (silkiness) and stickiness. Sand feels gritty and if present in large amounts, makes a rasping sound when particles are rubbed together. In contrast, silt feels silky and smooth, and when dominant it produces a feathery feel. Clay is sticky and plastic, and the particles stick to each other as well as to the skin.
- Rub the thumb over moist soil to determine whether it leaves a smooth, polished surface. This distinguishes soil with moderate amounts of clay (20 per cent or more).
- Try to form a cube with the soil. Cohesive cubes may be formed from soils with about 5 per cent or more of clay.
- Roll the soil into a thread. This is possible if clay is present in significant quantities, usually 15 per cent or more.
- Bend the thread into a ring. This is possible if clay is abundant (over 25 per cent), and the higher the clay content, the firmer the ring.
- Assign the sample to the appropriate texture class.

Composition of Soil

Soils are classified based on the size of particles.

Size of particles (in mm)	*Name of soil*
2.0 – 1.0	fine gravel
1.0 – 0.5	coarse sand
0.5 – 0.25	medium sand
0.25 – 0.1	fine sand
0.1 – 0.02	very fine sand
0.02 – 0.002	silt
0.002 <	clay

Soil texture chart



Source: Resources: Soil—WWF-UK

Ball Method

Requirements: Soil sample, water

- Mix soil from the site with some water and make a thick paste.
- Make balls from the paste and dry these in sun.
- Observe what happens to the balls after drying.

If the soil is rich in clay, it will form a solid ball which will not crumble when pressed with the fingers. If the sand content is high, once dry, it will crumble under slightest pressure. If there are more bigger sized particles such as silt or gravel present in the soil, the ball will break up as soon as it dries.

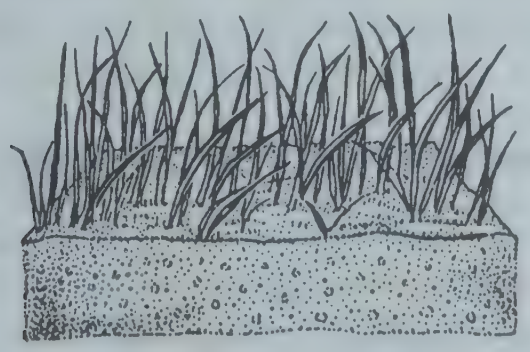
Observation Method

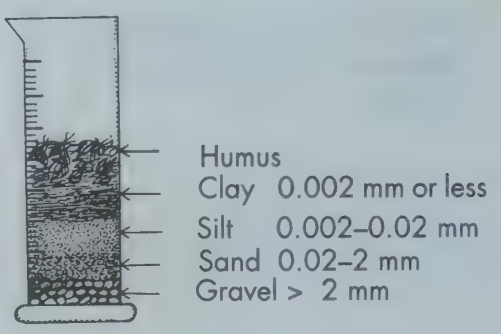
Requirements: Soil sample, glass measuring cylinder or jar, water

- Fill the measuring cylinder or glass jar with soil, up to 10 cm from the bottom.
- Add water to the soil and shake the mixture thoroughly. Allow the mixture to settle for a few hours. Different sized particles will settle at different levels in the measuring cylinder.
- Observe the various layers and determine how much of each category, i.e. clay, silt, sand, gravel, etc. are present in the soil.

The smaller the particles, more the water the soil will be able to hold. But soils with fine particles contain less air and crack in hot weather. Such soil cannot support big plants or trees, as the roots will not be able to breathe properly. If the soil does not retain enough water, the plants will not get enough water to survive. Best suited for gardening is loam, which is a mixture of soil particles of varied size, along with humus.

If the soil in the area is rich only in one particular size of particles, it may not be suitable for gardening. It is recommended to transport some soil from another area and mix it well with the existing soil.





Soil Types in India

Alluvial soils: This is by far the largest and most important soil group of India. It is formed by the deposits laid by the numerous rivers and their tributaries. Cereals and pulses grow best in this type of soil.

Black soil: Common in Maharashtra, western Madhya Pradesh, parts of Andhra Pradesh, Gujarat and Tamil Nadu. Cotton and groundnut are two of the plants that grow best in this type of soil.

Red soil: This soil is rich in iron. It is found in vast areas of Tamil Nadu, Karnataka, Goa, Daman and Diu, southeast Maharashtra, east Andhra Pradesh, Madhya Pradesh, Orissa and Chhotanagpur. It is utilized for Kharif crop cultivation; some varieties of rice and other cereal crops, and potato and sweet potato may also be grown in such soil.

Investigating the pH

Soil can be acidic, alkaline or neutral, depending upon its pH value, which may be determined using a pH paper.

Requirements: Soil sample, water, pH paper booklet (broad range for pH 2 to 10).

- Mix a small amount of soil in water.
- Let the particles settle down.
- Dip a piece of pH paper into the mixture. Do not touch the part of the paper that is being dipped into the mixture with fingers, as it may lead to an erroneous reading.
- Dry the pH paper.
- Compare the colour that emerges, with that on the cover of the booklet, to determine the pH of the soil.

A pH value of seven indicates that the soil is neutral; below seven indicates acidic; above seven indicates alkaline soil.

Highly acidic soil retards plant growth by affecting the efficiency with which the plants absorb nutrients from the soil.

Liming of the soil is one way to reduce its acidity. A local gardener or farmer may be contacted for assistance in this.

Water

Plants need water for healthy growth but over-watering can be detrimental. In the first year, a sapling should be well watered once a week. Once the tree has fully grown, there is no need for regular watering, except during extremely dry spells. A vegetable garden requires regular watering once in every three or four days. Watering patterns also depend on the climate of the region—it is obviously more frequently required in drier climates.

Investigating water availability

It is necessary to investigate the site to determine where the water sources are located, whether they are reliable sources, the distance from the plantation site, available means of transporting the water, including the possibility of diverting water from washing and drinking water areas. Use of drip or sprinkler irrigation systems may also be explored.

Step 3: Understanding the Environmental Conditions

Different plants have different climatic requirements for optimal growth, so it is important to understand the climatic conditions of the region before deciding on the plants to be grown.

One way by which climate may be classified is on the basis of the rainfall in the region. Contact the nearest meteorological station for information on the amount of annual rainfall in your area. The table 'What Grows Where?' may help classify the area.

Step 4: Species Selection

The selection of species to be grown in the area again depends on the specific climatic conditions. As far as possible, plants which grow locally should be chosen.

Investigating the local flora

It is possible to get some idea about common local plant species by conducting a survey in the neighbourhood, visiting a nearby nursery, garden or seed centre, or talking to knowledgeable individuals who have lived in the area for a long time. From this, a list of local plants: trees, vegetables, flowering plants, medicinal plants, and those that can be grown for fodder, could be formulated. This can serve as a menu for selecting plants for specific conditions for the greening project.

If a vegetable garden is planned, then seasonal vegetables may be grown. Sword bean, capsicum, cucumber, french bean, ladies finger, bottle gourd, brinjal, maize, etc., are some summer vegetables. Carrot, radish, turnip, cabbage, cauliflower, peas, beans, tomatoes, etc., can be grown in winter.

What Grows Where?

No.	*Rainfall*	*Class*	*Region*	*What May be Grown*
1.	> 240 cm	1	North-East, West coast, South of Bombay	As these are regions of high rainfall, trees flourish here.
2.	168-240 cm	2	Same as above	Any number of local trees could be used for greening purposes.
3.	110-168 cm	3	Parts of Bengal and Bihar	Classes 3 & 4 are regions of medium rainfall. Here many of the vegetable crops, such as radish, mustard, peas, carrots, onions, beans, cucumbers, brinjal, etc. and flowering plants such as jasmine, phlox, hibiscus, rose, chrysanthemums, etc., could be grown.
4.	72-110 cm	4	South Tamil Nadu, Central India	
5.	< 72 cm	5	North-West India, Rajasthan	This includes regions with very little rainfall. Plants which require minimum water should be planted such as *dhak, armato, saru, nilgiri, khajoor,* cacti, etc.

Each of the above classes would also have a warm and cool season. Planting of seasonal vegetables and flowers will depend on this, as well as on the soil type and water availability.

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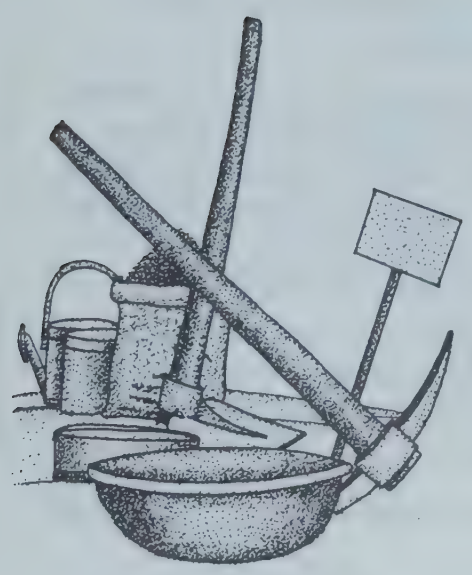
Plants You Can Plant

Mulberry *(Morus alba)*
Jamun *(Eugenia jambolana)*
Dhak *(Butea monosperma)*
Gulmohar *(Delonix regia)*
Custard apple *(Annona squamosa)*
Ber *(Zizypus sp.)*
Tamarind *(Tamarindus indicus)*
Peepal *(Ficus religiosa)*
Drumstick *(Moringa oleifera)*
Kachnar *(Bauhinia variegata)*
Siris *(Albizia lebbeck)*
Babul *(Acacia nilotica)*
Poplar *(Populus ciliates)*
Semul *(Bombax ceiba)*
Mango *(Mangifera indica)*
Arjuna *(Terminalia arjuna)*
Citrus species

Schools that have limited space may grow creepers, which could cover the school compound walls.

Money plant *(Pothos sp.)*
Jasmine *(Jasminum sp.)*
Morning glory *(Ipomea sp.)*
Trumpet vine *(Tecoma sp.)*
Asparagus *(Asparagus officinalis)*
Railway creeper *(Campanula sp.)*
Golden flower *(Bignonia sp.)*
Tube flower *(Clerodendron sp.)*



Some of the flowering plants that may be grown include different varieties of jasmine and roses, phlox, dahlias, chrysanthemums, shoe flower, Indian oleander, night queen, etc.

Some of the medicinal plants that may be grown include *neem, amla, tulsi,* sacrificial grass, thatch grass, great reed etc.

Commonly used fodder plants for cattle may also be grown, which include *bakain, banj, beru, bhimal, dudhila, kharik, quavial, siris, shahtut, timul,* etc. Apart from these, some of the usual grass plants on which the cattle graze in the neighbourhood may also be planted on the site.

Step 5: Preparing the Plot for Planting

Preparation of Soil: This should be done preferably four to six weeks before sowing or planting. For tree planting, only the area immediately surrounding the actual site of planting needs to be prepared. For other plantations, preferably the entire area should be prepared. For potted plants, well-mixed soil should be used. In the case of nursery raising, polythene bags should be filled with well-mixed soil along with manure.

Soil preparation begins with clearing the site of thorns, weeds, stones, etc. Then the soil is dug and turned up, in order to mix the topsoil and subsoil with nutrients, aerate the soil, kill unwanted microbes, and break up clumps.

A shovel is required for soil preparation. The school gardener may have one and he may be asked to teach the students to use the same.

A simple way to prepare the soil

- Remove the topsoil and set it aside.
- Remove the subsoil and keep it separate.
- Return the topsoil into the pit first, and then top it with the subsoil.

After this, compost manure should be added and forked into the soil using either a fork (if available) or any easy-to-handle metal rod. The surface should be levelled, using the back of the shovel if the area is small. If it is large, a bamboo pole may be rolled and gently patted over the soil. Then the soil should be watered.

If the plantation activity is to commence with the beginning of the school year, soil preparation could be done prior to the summer vacations or immediately after school reopens.

Further soil preparation depends on the type of planting that has been planned.

Step 6: Planning of Plantation

While planting, the following points should be kept in mind:

- Trees should be planted at a distance of at least eight metres from buildings.
- When planting more than one tree, usually a distance of at least one tree length, in other words the height the tree is expected to attain at maturity, is to be maintained between two trees. This could be determined either by observing other full-grown trees of the same species in the locality, referring to a book, or asking local gardeners.
- Gardens should not be placed under the shade of tall buildings or trees.
- If a large area is to be planted, preferably it should be laid out in small beds of nine m^2, with small irrigation channels. This makes it is easier to tend the beds without trampling over the plants, and to drain off the excess water.

Step 7: Protection of Saplings

After obtaining the necessary permissions, a fence should be erected around the plantation site. An initial mechanical fence could be used along the boundaries of the sites. This could be made out of wooden stilts or bamboo poles and barbed wire, which is stretched and twisted across and around each pole. The distance between the wire lines should be such as to prevent grazing animals or dogs from entering the site. Fast- growing hedge plants such as *henna*, *agave*, or thorny cactus, planted in the month of March-April, would reach a sufficient size by the end of the rainy season to provide protection.

Step 8: Maintenance

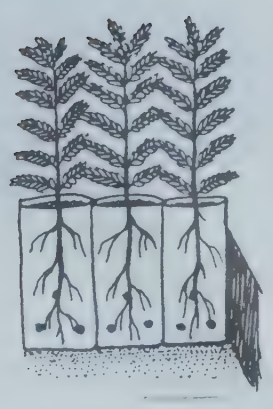
Once plantation has been carried out, the following activities should be carried out on a regular basis.

Watering

Trees	copious watering once a week.
Grasses	watering frequently enough so that the area does not dry up.
Vegetable garden	regular watering once every three to four days including wetting of the leaves.
Flower garden	sprinklers may be used to avoid water logging.

Weed Control

Weeds are unwanted plants that utilize the water and nutrients in the soil, thereby affecting the growth of other plants. These should be regularly removed either by hand or using simple implements.



Application of Nutrients

Some of the nutrients which support efficient plant growth may be lacking or in insufficient quantities in the soil, and may be supplied through addition of chemical or organic fertilizers.

Compost manure is beneficial for all plants. The students may be asked to separate their organic waste such as left over food, leaves, vegetable and fruit peels, etc., from non-biodegradable wastes, for use in a compost pit. This may be prepared on the school premises itself and maintained throughout the year. (For instructions on how to make a Compost Pit, see page 31)

Other materials that may be used as manure are cow, horse, sheep and goat dung, leaf mould, green manure, oil cake, night soil and chemical fertilizers. Always mix the manure with soil first before applying to the plant.

Step 9: Plantation

The actual plantation process depends on what is to be planted. Steps for different kinds of plants are given below.

Nursery Raising

Students could be encouraged to start a nursery. This could be an important activity in places where there is a shortage of space. Sale of saplings could also generate income.

Seeds of local trees like *neem*, pongamia, gulmohur, copperpod, rain tree, etc., are to be collected during the appropriate season.

Seeds which have a thick coat need to be soaked in water overnight before planting. Seeds like that of cassia need to be activated by placing them in hot water for about three minutes.

Seedlings should be sown in plastic bags, of about 20-30 cm in length and 10 cm in diameter, which may be purchased or collected, e.g. polythene carry bags of the correct size.

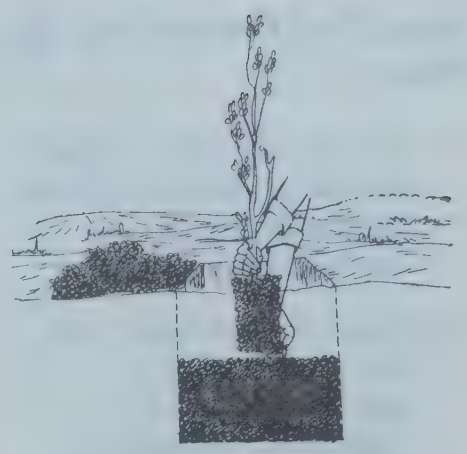
- Mix equal proportions of red earth, manure, garden soil and sand, from which larger stones have been removed.
- Fill three-fourths of the plastic bag with this mixture.
- Place one or two seeds in each bag, inserted to a depth which equals the size of the seed.
- Keep the bags in a shady place away from direct sunlight.
- Sprinkle with water regularly to keep the soil moist, preferably in the mornings and evenings.
- Wait for the tiny seedlings to sprout. Weeds should be removed as and when they appear.

Tree Plantation

Tree planting should be done prior to the rainy season.

Obtain saplings from the neighbourhood nurseries. Forest Department Nurseries also supply saplings, usually free of cost.

- Dig a pit 120 cm x 120 cm x 120 cm.
- Carefully place the sapling in the pit. The tap root should be upright in the pit.
- Before filling, part of the pit (preferably one-third) should be first filled with compost manure. Then the soil should be put in and pressed down tightly.
- Young trees need a large amount of water once a week, rather than frequent surface sprinklings.
- Saplings would be sufficiently protected with tree guards, rather than fencing off the entire area as required for a garden.



One of the most popular tree guards is a used coal-tar drum with the base and top removed, and with big holes cut on the drum's surface. Thorny twigs may also be placed around saplings to prevent grazing, but these are less effective. Thin bamboo poles surrounded with mesh is another option. Tree guards should be at least 0.6 m x 0.6 m, or approximately 2 m in diameter, if a round guard is used, with a height of 2.25 m.

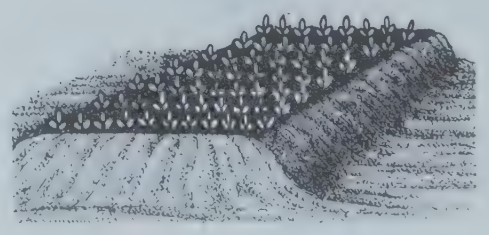
Gardens

Vegetable Garden

An area intended for vegetable gardening should be fully exposed to the sky and sunlight and as far away from trees as possible. The area should be protected from hot and cold winds by a fence or a hedge.

Mix the topsoil and subsoil—the soil should be dug and turned up and then the ground leveled. On top of this add a layer, of about ten cm, of farm yard manure or compost manure. (See page 14 for details on soil preparation).

In case of vegetable crops like tomato, brinjal, chilli, cabbage, cauliflower, onion, etc., it is desirable to sow seeds in well-prepared, raised nursery beds 60 - 70 cm wide. Seeds should be sown thinly in lines 5 cm apart at a depth of 1 - 1.5 cm. Nursery beds should be watered with a fine sprinkler after sowing, avoiding flooding at all times. The nursery should be located in an area which does not receive too much hot sun, and would not be flooded by heavy rains. This could be achieved by digging drainage canals around the area to drain rain water quickly. In areas with extreme temperatures, either



Beautiful Flowering Plants

- Jasmine—there are different varieties growing in different regions. Propagated by cuttings during rains.
- Rose— It needs loamy soil, well manured and maintained properly. Cuttings can be used to propagate the plant.
- Phlox— the seeds are sown in January. It produces flowers in the months of June and July.
- Dahlias—can be propagated from tubers obtained from nurseries. Should be planted in July. They have to be supported with stakes. The flowering season is December- February.
- Chrysanthemum—seeds should be sown in October and should be planted in good manured soil and watered regularly.
- Marigold, shoe flower and office flowers are the other flowering plants that can be planted.
- Bougainvillea—comes in different colours and shades; can be planted along the fence. These are propagated by cuttings.

too cold or too hot, for saplings to survive outdoors, nurseries may also be raised in greenhouses.

Tomatoes, brinjal and ladies finger should be sown on plots with ridges and furrows. The seeds should be sown in ridges and irrigated in the furrows. The ridges should be 0.6 m apart and should preferably run in a North-South direction .

Mustard can be sown by broadcasting. Carrot can also be sown by evenly spreading the seeds on the plot. Later thinning (to reduce the crowding of plants) needs to be done.

Peas and beans should be sown in rows with a distance of 0.3 m—0.6 m in between. These plants may need support as they grow, which may be provided in the form of bamboo stilts.

Watering should be done at least once every four days.

The vegetables may be either distributed among the students and other staff involved in maintaining the garden, or sold and the money used to purchase tools and implements, seeds, etc. necessary for gardening.

Flower Garden

A flower garden is always a beautiful sight that also attracts butterflies and other insects, that play an important role as pollinating agents. Flowers attract different kinds of insects, like butterflies, beetles, moths, etc., as well as birds and animals.

The students may be asked to observe the different kinds of insects/birds/animals that come to feed on different flowers, at different times, learn about the importance of insects and birds as pollinators and also their role in seed dispersal, discover more about the adaptations of flowers for better pollination and seed dispersal, and of the adaptations of the physical characteristics of insects/birds to help them to suck nectar or eat fruits.

Flower plants can be planted either singly or in groups. When grown in groups, one type or a variety of plants may be grown, to create a colourful appearance.

There are many different flowers in India and each region has its own special varieties of flowers. A survey around the locality will give an idea of the flowers which can be easily grown and they can be procured either in the form of cuttings or seeds for plantation in the garden.

In case there is no open ground available for gardening, potted plants can be grown on terraces. Pots can be filled with loamy soil to grow either cuttings or seeds.

Medicinal Garden

Different parts of many plants, leaf, bark, root, fruit, etc. have been used from ancient times in indigenous health practices in India. In recent times this knowledge has been used even in modern medicine to combat various diseases.

Students may be encouraged to find out about and grow some medicinal plants, trees, shrubs or herbs, some of which grow even where space is limited. If no land is available, plants like *tulsi* may also be grown in pots. They can then use these for prevention and cure of minor ailments for themselves and their families, and validate the effectiveness.

Medicinal trees may be propagated through either seeds or saplings.

Obtain seeds from the neighbourhood, private nurseries, or Forest Department nurseries or ayurvedic gardens.

Some seeds such as *amla* and *neem,* need pre-treatment like overnight soaking. The seeds have to be sown in well turned soil, at a depth equal to twice its diameter. Two to three seeds may be placed together. Once the seedlings emerge, all except one seedling showing proper growth should be removed.

Saplings are available from private or Forest Department nurseries.

- Dig a pit roughly 1.2 m x 1.2 m x 1.2 m. After removing the polythene cover by slitting it, gently place the sapling in the pit. Care should be taken not to damage the roots. Fill the pit with a mixture of soil and compost manure.
- Students can find out about the traditional medicines obtained from local plants and can try to grow those plants as part of their project.

Amla *(Phyllanthus emblica)*

Belicaraga (*Cyanodon dactylon)*

Vasaka
(Adhatoda zeylanica)

Medicinal Values of Some Common Plants

Plants	*Used in*	*Useful part*	*As cure for*
Sacrificial grass *(Desmostachya bipinnata)*	Ayurvedic Medicines	Root	acidity, dysentery, blood related diseases, eye problems, etc.
Belicaraga *(Cyanodon dactylon)*	"	Whole herb	"
Thatch grass *(Saccharum spontaneum)*	"	Root	"
Great reed (Saccharum arundinaceum *Arundo donax)*	"	Root	"
Neem (*Azadirachta indica*)	"	Leaves Tender-branches	insect repellant, cleaning teeth.
Tulsi (*Oscimum sanctum*)	"	Leaves	sore throats
Vasaka *(Adhatoda zeylanica)*	"	Leaves	coughs and colds
Amla (*Phyllanthus emblica*)	"	Fruit	rich source of Vitamin-C, is used for healthy hair.
Borsali (*Mimusops elengi*)	"	Seeds	used in toothpaste

Growing Plants for Fodder

- Plants that are used as fodder may be grown, especially if there is a demand for fodder in the neighbourhood.
- Students may choose any number of the commonly used fodder species or choose any from the list given in Step 6. Once the plants have grown, they could request cattle owners to collect it at regular intervals.

Natural Regeneration

Students could receive first-hand information about nature's capacity to recover through a simple project on natural regeneration, to observe how nature, if left undisturbed could reclaim any barren land area. Preferably, initiate this activity before the rainy season to be continued well beyond it, as fast growth of plants takes place immediately after the rains, as a result of availability of water.

- Identify any unused plot where there is little or no vegetation.
- Obtain permission from the concerned authorities.
- Fence the area with bamboo stilts and wire mesh, so that while the area is well protected, it does not present difficulties for observation.
- Students should maintain an observation book/chart to record the appearance of plants. Grasses are generally the first plants to colonise such a plot, followed by shrubs. They could also observe animal life inside the plot at different times of the day. The teacher or any other knowledgeable person could help them in identification. If they are unable to make an identification, they could draw what is to be identified, in as much detail as possible and to the best of their abilities, and send it to a nearby college or university.
- After they accumulate observations, first for one season and then for over a period of one year, etc., the students should make a flow chart showing the different plants in order of occurrence.
- If noticeable changes do not occur within one academic year, the activities may be continued by the same group the following year, or by another group which takes up the activity.
- During the course of this project students could prepare a herbarium to serve as a guide to others, either in the identification of some of the plants that are able to grow in that area or for use by other students to learn about succession and natural regeneration in that area.

If natural regeneration is allowed for an extended period of time in a large plot, the area would eventually be occupied by vegetation typical to that region. This is known as the process of succession, wherein the pioneer species is gradually replaced by other species as the conditions on the plot improve. Such a project would not only result in reclamation of barren land, but also clearly demonstrate the regenerative powers of nature when left to itself.

Preparing a Herbarium

- Collect small plants without damaging the leaves, flowers(if any) and roots. To do this, first loosen the soil around the roots.
- If the plant is dusty, then wash it gently with some water, again taking care not to damage any plant parts.
- Blot the water on its surface by putting the plant in between folds of filter paper or newspaper. Repeat until all the surface moisture has been absorbed.
- Place the plant neatly between the folds of a fresh newspaper, taking care not to damage the plant. If there is a flower, as much of it as possible should be visible properly.
- Place two to three more newspapers over this and then put an even heavy weight on these newspapers.
- Change the newspapers everyday, taking care not to damage the plant.
- Once the plant is completely dry, it may be stuck on a herbarium sheet with tape.
- The herbarium sheet should have the following details in the right hand corner:

  Common name of the plant
  Scientific name of the plant
  Family
  Description
  Date of collection
  Name of the collector

- A botany book or teacher could help in correct identification of plants.

Sustaining the Greening Programme

This project could be continued in the following year either by the same group of students, if possible, or by another group who enter that particular class, if it is a class-based activity, or to that particular club, if it is a club-based activity.

A rough outline of activities to be carried out in the following academic year should be made before the school closes for vacation, so that the students may conduct some surveys and collections during the holiday period, e.g. determining the nature of the soil, the local flora, sources of water, possible waste water sources that could be diverted to the gardening area, etc.

Outcomes

Participation in such greening projects would help students learn about the various aspects of planting and maintaining plants of different kinds. Along with this they would gain knowledge about soil types, climatic conditions of the area, the plants themselves—what sort of plant grows in what area, in which season, how they support other life forms, how different parts of the plants are useful, etc. In the process they will also realize the needs of the plant.

Kids Did It!

Vanamahotsava is an annual event where large scale tree plantation takes place all over the country. Unfortunately, while millions of saplings are planted during this period, not as many survive or grow. Often this is due to lack of essential care. Students of village schools around the Sariska Tiger Reserve in Rajasthan attempted to change this scenario. These students were members of village *Bal Sabhas* that were already involved in out-of-school environmental education activities initiated by CEE. Twenty days before the plantation programme, the students began preparing banners and placards. Villagers were informed about the date for distribution of saplings three to four days before the event; a series of pits were dug for saplings near the schools, village houses, and along the route of a planned *padyatra* (rally); saplings of indigenous and fruit trees were procured from the Forest Department and kept carefully. The celebration day began with a meeting of all the school children, teachers and principals. After talks by resource persons on the importance of trees, there was a demonstration of the proper way to plant and care for saplings.

After the function the Bal Sabha members embarked on their *padyatra*, accompanied by a few teachers and youth volunteers. The saplings followed, on a camel cart! As the *yatra* went through villages and settlements, the students waved their placards and shouted slogans about trees. As they proceeded, they planted saplings in the prepared pits along the route, and distributed some to the villages. At each village, the *yatris* met students from the village schools and shared ideas with them, talking about trees and plantation. Returning to the school each student also received two saplings. After the event, *Bal Sabha* members continued to keep an eye on, and care for, the saplings they had planted. The process of growth was observed and meticulously recorded in notebooks. This approach to greening not only helps to sustain the activity and interest, but ensures that not just planting, but nurturing and raising plants is the key to successful greening.

Source: Santosh Kumar Gupta, CEE

Trees and Gardens: Calendar of Activities

Key to symbols

- ♣ Flower garden
- ♦ Vegetable garden
- ♠ Trees
- ● Common to all the above

Month	Activity
Early July	● Deciding on the activity schedule
	● Selecting the site
	● Procuring implements
	● Preparing compost pit
	● Cultivating soil (tilling, manuring)
	● Fencing
	● Purchasing seeds, saplings
Late July (before the rains)	♠ Planting
	♦ Preparing the ground into ridges and furrows
	♦ Sowing of carrot, cabbage, peas, ladies finger, capsicum, brinjal
	♣ Planting Dahlia tubers.
	♣ Planting of rose and jasmine cuttings
August	● Tilling soil
	● Removing of weeds
	● Digging canals to drain excess water in case of heavy rains.
	♣ Regularly applying manure to rose plants after rains
September	♣ Providing regular maintenance; watering once in four days for vegetable and regular watering for flowering plants .
October	♠ Providing regular maintenance
	♦ Harvesting some of the vegetables—carrot, peas, etc.
	♦ Depositing the leftover parts from the harvested vegetable plants in compost pit
	♣ Sowing of chrysanthemums
	♣ Providing regular maintenance, tilling the soil, removing weeds, watering
November	♠ Providing regular maintenance
	♦ Re-sowing in harvested areas
	♣ Pruning rose and other flowering plants
December	● Providing regular maintenance
January	♠ Providing regular maintenance
	♦ Cultivating soil, removing weeds, etc.
	♦ Harvesting carrots, peas, etc.
	♦ Applying liquid manure to flowering plants, vegetable garden
	♣ Sowing Phlox
February	♠ Providing regular maintenance
	♠ Preparing the soil and where harvesting has already been done, tilling, ploughing and manuring
	♦ Preparing vegetable garden
	♦ Sowing *kakri*, brinjal, *kaddu*. As *kaddu* needs support, it should be positioned to trail over the compound wall or the ground.
March	♠ Providing regular maintenance
	♣ Propagating of Bougainvillea cuttings
	♣ Collecting and storing seeds from other flowering plants for future use
April	♦ Sowing seeds of bean, capsicum, ladies finger, brinjal
	♦ Providing regular maintenance: watering, turning and cultivating topsoil, etc.
May	♦ Providing regular maintenance
June	♦ Applying different kinds of pesticides like neem, tobacco extract, etc. to prevent damage from insect pests.

Before the school closes, arrangements must be made for watering annuals during the vacation period.

CLEAN UP

- An average person in India generates 0.15 to 0.35 kg of garbage daily.
- A banana peel takes three to four weeks to decompose. A plastic shopping bag may never decompose.
- Contamination by chemicals renders water unfit for consumption and often leads to many health problems in humans and animals.
- Human settlements discharge four times as much waste into water bodies as do industries.
- 70 per cent of all water available in India is polluted.
- In India, out of 3,119 towns and cities, only 217 have partial or complete sewage treatment facilities.
- Stagnant pools of water are breeding grounds for mosquitoes which spread deadly diseases like malaria and dengue fever.
- Contaminated water leads to many diseases like cholera, gastroenteritis, typhoid, jaundice, diarrhoea and dysentery. Such water borne diseases account for 66 per cent of all illnesses in India, and subsequently about 73 million lost work days.

Photo : Sunil Jacob

Activities that involve cleaning the immediate environment will have the most 'visible' results—not only to the children involved, but also the community at large. Such activities will help to generate among the children, a greater sense of involvement in their neighbourhood and the community.

Why Clean Up?

- An unsanitary environment attracts flies and other insects which act as vectors of various disease-causing organisms.
- Such projects help reduce pollution, as the current methods of waste disposal, either landfills or incineration, lead to environmental pollution.
- Recycling and re-using different materials will not only reduce unwanted littering but also conserve rapidly diminishing natural resources.

Clean surroundings are important for healthy living and for a sustainable future—so cleaning up is very important.

What Can Students Do?

They could work to protect their school, home, neighbourhood, etc., from becoming a huge dustbin. Students could take up "Clean-Up" campaigns or action projects which involve not only themselves, but also others in the school and community. Given below are some ideas for such projects.

1. Carrying out a "Clean-Up the Surroundings" campaign
   - keeping the school and its grounds clean
   - working to keep a street or neighbourhood clean, may be with a neighbourhood committee
2. Preventing water contamination and stagnation in the school and neighbourhood
   - ensuring that stagnant pools do not become breeding grounds for mosquitoes
   - maintaining a local water source (existing well, tank, hand pump, tap, etc.) and guarding against water waste, contamination, stagnation, etc. around the area.
   - cleaning storm water drains before the monsoon season
3. Adopting a local monument and keeping it clean
4. Taking up a project to recycle and re-use
5. Initiating a campaign on reducing waste

In order for such projects to be successful, proper planning and orientation of students play an important part. Some basic steps provide a common framework within which this could be done.

1. Becoming aware of the need to keep the surroundings clean
2. Selection of project site /area and project
3. Planning the project
4. Carrying out the project
5. Evaluating the success of the project and finding ways to sustain a clean surrounding.

When Will They Degrade?

Different material degrade at different rates. The effect of any waste will depend on how long it stays as it is in the environment. The longer it stays unaltered, the more will be its negative effect.

Material	*Time taken to degrade*
Banana Peel	Three to four weeks
Paper bag	One month
Cotton bag	Five months
Wood	10-15 years
Aluminium can	200-500 years
Plastic bag	One million years
Styrofoam container	Eternity

Waste Generated in an Average Indian City

Waste generated in an average Indian city consists of the following:

Content	*Percentage*
Vegetables/ waste food ,etc.	75.0
Paper	4.0
Dust	2.0
Metals	0.4
Glass	0.4
Textiles	3.0
Plastics	0.7
Other (stones, ceramics)	7.0
Wt./person/day	414 gms
Wt./dwelling/day (6 persons)	2.5 kg

Source: A Field Manual on Garbage Composting, CEE

Step 1: Making Students Aware of the Need to Keeping the Surroundings Clean

Students first need to be sensitized to the lack of cleanliness in their surroundings, oriented to the consequences of such surroundings, and motivated to feel that they would be able to make a difference.

This could be accomplished in a variety of ways.

Visits

Take students to a nearby garbage dump to see where all the collected garbage is dumped. Ask them to observe and note what kinds of garbage are dumped there. They should also note what kinds of insects and animals are found in and around the vicinity. Do they find any rag-pickers going through the garbage? Proper precautions must be observed by students, for instance, wearing gloves before they touch anything, covering their face with a piece of cloth or mask, wearing protective footwear, etc.

The size of the dump, and the presence of flies and rodents, along with the stench may provoke the students to think about the need for not only a cleaner home, but also an adequate, systematic way of handling garbage at the town/city level.

The observations can be discussed after the visit. The students could determine which diseases are caused or spread by the flies and animals found in the garbage dump and what steps, if any have been taken to prevent the spread, for instance, by conducting a survey of the area near the dump.

They may also try to find out what the rag-pickers search for in these dumps, what hazards they face, whether their job could be made any easier and less unhealthy. How rag-pickers could be involved in clean-up projects may also be discussed.

Lectures and Discussions

A health and sanitation worker from the Primary Health Care Centre in the area or an NGO, may be invited to talk to the students about the need for clean surroundings, with stress on the diseases caused by unsanitary conditions. A discussion could also be held on spread and control of infectious diseases. An expert or a person involved in solid waste management could talk to the students about the problems of solid waste management, who could assist in this and how, i.e. role of individuals/households, civic authorities, etc.

Discussions could be held at regular intervals on the reasons for solid waste management becoming a serious problem, especially in urban areas, e.g. due to sudden increase in population, lack of infrastructure to cope with the rapidly

increasing volume of garbage, changing lifestyles, etc. Discussions should also consider recycling of waste, stressing how this helps in conserving natural resources and energy and reducing risks to our health and environment, etc. Students could be taken on a trip to landfill areas or any recycling unit to see first hand what happens in these units.

Audio Visuals (Videos/Slide Shows)

Visual aids help to illustrate or reiterate some of the points raised in lectures/discussions, or help to put the findings of a visit in perspective. Some videos provide a global view of the issue, while others may teach skills of garbage management. Others which document relevant cases/experiments could serve as guidelines or pointers for students ready to take up similar projects.

After showing a video/slide show on a particular subject, the teacher could hold a discussion. If the video just describes the problem without offering a solution, then the students could be asked to think about solutions.

If the video does describe a solution, then the students could be asked to think about the appropriateness of the solution and discuss whether a similar effort could be made for a locally known problem.

Step 2: Selection of Project Site/Area and Project

Once the students have developed an understanding of the problem, they should survey their school and neighbourhood to determine what problems exist in that area (e.g. open garbage dumps, pools of stagnant water, litter in the school or in the nearby park, etc.). The nature of the problem will lead them to deciding on the project—whether it should be cleaning up the site, cleaning stagnant pools of water, segregation and disposal of waste, or recycling.

For this purpose the students could use the survey sheets given on pages 38, 39 and 40, either as they are or, in a modified form, for their various surveys to collect information which would help in identifying and understanding the reasons for garbage dumping or for stagnant water. Based on this, students can decide on the site for the project—i.e. school or neighbourhood, as well as nature of the project. This also determines whether students carry out the project themselves, or whether community involvement would be necessary at any stage.

The project not only aims at making a positive difference through visible action, but it is also meant as a learning experience for the students in co-operation, planning, management, etc. As such it is advisable that the students take a

Video Watch

Some video films that the students could watch to increase their awareness of the problem are:

- Race to Save the Planet: Waste Not Want Not
- Video Spots on garbage: "I Care for the Environment", "Littering", "Cloth Bags Are In, Plastic Bags Are Out" and "Cans Add to the Garbage".
- "Garbage—Our Problem"
- "A Way for Garbage"
- "Clean up Kodagu"

These videos can be obtained from CEE, Ahmedabad. Other sources of audio visuals are given in Appendix on page 86.

lead role in deciding and planning the projects. Through the lectures, videos etc., they would have already got some ideas about the issues and the sort of action which would lead to certain results.

Step 3: Planning the Project

Once the students have decided on their projects, it is necessary to evolve a plan of action. The following factors must be considered while planning, as they may determine the eventual success of the project:

- How much time would the students have to carry out the project, e.g. how many hours/week, and for what period of time—one term, one school year?
- If the project is to be carried out in the school, it will be necessary to take prior permission from the Principal.
- When the projects involve communities, prior consent of the residents or discussions with society leaders, are necessary. This specific component should be planned from the start.
- Whether the project requires the help and support of Municipal Authorities and/or any other local organizations should also be taken into consideration.

It is also important that the students from the start, inform those who are indirectly involved in the project regarding the aims of the project and how much and what sort of co-operation is expected from the rest of the school or from the community. For this, different media like posters, presentations, plays, etc., would be useful. Once the students have their attention, they could discuss the plan of action and request their specific co-operation.

Step 4: Carrying Out the Project

Students carry out the chosen project as per the plan they have developed. Some projects are described in the following pages. This could serve as a guideline for planning and implementation of other projects.

Step 5: Evaluating the Project

Once the project is completed, the students should survey the project area again to determine the changes they were able to bring about. They could use the same survey method they used at the beginning of their project for this purpose. They should also note whether the community, has undergone, any attitudinal changes. In other words, have they started a process of thinking, and thereby taking action to prevent their school/ neighbourhood from becoming a large dustbin?

Some Project Ideas

Clean-Up Campaigns

Clean-up campaigns could be taken up by the students in their homes, classrooms, school grounds, neighbourhoods, etc.

School-Based Campaigns

A campaign to clean up the school could include steps to reduce littering, planning appropriate and effective disposal of generated waste, and creating awareness among other students about the need for clean surroundings as well as motivating them to join the campaign.

Having decided that the school (classrooms, common spaces and grounds) need to be "cleaned up", students should initiate the project with a systematic survey of what kind of litter/ garbage is found in the project area and where it is a major problem, e.g. school grounds, near the canteen, corridors, etc.

Groups of students may inspect the different areas every day for one week, observing and listing the types of garbage/litter they find, the quantity and also where it was found. For example:

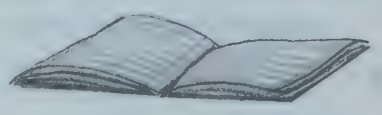
Type	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
Paper						
Plastic						
Wrappers						
Food Waste						

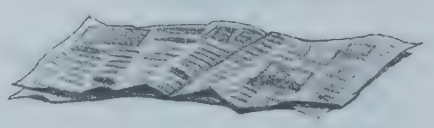
Paper, and wrappers and plastic may be counted by the number of sheets or pieces. At the end of the week, students can compile their notes and discuss the findings.

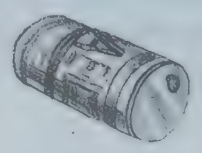
Collection and Segregation of Waste

Once the students have become aware (through their visits, lectures and audio visuals), of the different kinds of waste generated in the school and the ways in which they could be recycled, they can then start a project to encourage proper disposal and segregation of wastes. For dry waste, such as paper or plastic, they should take the permission of the Principal to store the segregated waste, until the time of disposal. Depending on the storage space available, they could plan the intervals of disposal.

Since the success of the campaign would involve the co-operation of other students and staff members in the school, they should inform them about the project of collecting and segregating waste, through announcements in the assembly, individual class announcements, displays on the notice board







and posters. The information campaign should highlight the advantages of segregation of waste, how to segregate and how the segregated waste will be disposed. They should request others to co-operate and put the different categories of waste in specified dustbins.

Students could request the support and co-operation of members of the school staff in-charge of cleaning the school premises and thus involve them directly in this project. The cleaning staff could be requested to collect the segregated waste and place it in the previously identified storage space.

Students could make different dustbins from used cardboard boxes for the various kinds of wastes. Each bin should be labelled for the kind of waste that should be put into it: used notebook paper, chart paper, used polythene bags, etc. Such boxes should be placed in each classroom and office, or in a common area. In the canteen, students could also place different containers for leftover food, plastic containers and bags, paper trays, etc.

In the initial phase of the project it would be useful if one or more of the students involved in the project visit the different areas of the campus/school grounds/canteen, at a specific time (during lunch hour) to ensure that the other students put the waste into the different bins.

For the success of such a project, it is important that the students' actions are encouraged by the school management and noticed by the rest of the school. The groups' performance should motivate other students to join the campaign. Such a project is sustainable only when all are involved and keeping the surroundings clean becomes a habit.

What Can Be Recycled?

- Paper may be re-pulped
- Textiles may be used to make dusting cloth, felt and machinery wipers
- Tin may be electrolytically extracted from tin cans
- Other metals may be re-smelted
- Dust and cinder may be used for brick-making
- Broken glass may be used for manufacturing glass or for abrasive paper
- Aluminium may be separated by eddy currents and recycled
- Vegetable, waste food, etc., may be processed as animal feed or composted.

Kids Did It!

Students in several schools have thought up "eye-catching" ways of attracting attention to the problem of garbage. In Calcutta, West Bengal, children collected all kinds of trash—boxes, tins, paper, plastic bags, etc., to build a TRASH-O-SAURUS in the school lobby. This was an effective way of demonstrating how much material is thrown away.

Students in Jaipur, Rajasthan, and New Delhi, collected non-biodegradable garbage from their homes, including used tubes, clips, tetra packs and much more. Over a bamboo frame they fixed all the trash to create a huge Ravana-like garbage man. Such a 'sentry' at a neighbourhood plot or near a garbage dump could act as powerful way of communicating about garbage.

Source: Gayatri Moorthy, New Delhi

Disposal of Waste

Dry Waste

Students may find out about a local *kabadiwallah*, who picks up the segregated dry waste (paper, plastic etc.). If the quantity is large, they could make arrangements for the collected waste to be picked up at fixed intervals by a nearby recycling centre.

The profits from this could either go to the school or the class/ group which organizes these programmes.

Organic Wastes or Biodegradable Wastes

Kitchen waste, leftover food materials, leaf litter, etc., could be recycled as compost in a compost pit. If there is a problem of space, then composting can be done in large flower pots.

In co-operation with school authorities, students could decide where in the school grounds to make a pit.

Compost manure will be ready in three to four months, which could be used in the school garden. If the prepared compost is more than what is required for the school garden, then they have the option to sell it, either in the school itself (to the staff and other students who are willing to take it) or to any shop that is willing to market it.

Kids Did It!

As part of a campaign called "Clean-up Kodagu", initiated by CEE-South, school children went out into the community to collect garbage, which was then sold to recycling agents. 50 per cent of the money generated from collecting and selling the waste was kept by the schools as corpus to form Eco-clubs, and was used for camps, excursions and other environmental education activities.

Source: CEE-South

New from Old

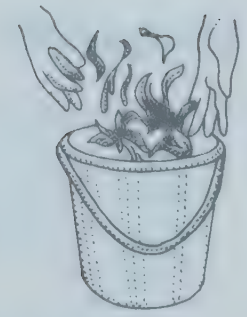
Students may enjoy trying their hand at making new things from old. Some suggestions are given here. They may also devise many ideas of their own.

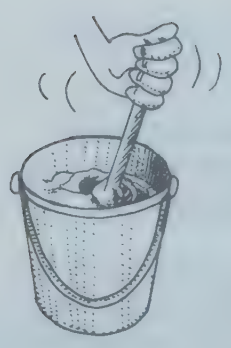
Making Recycled Paper

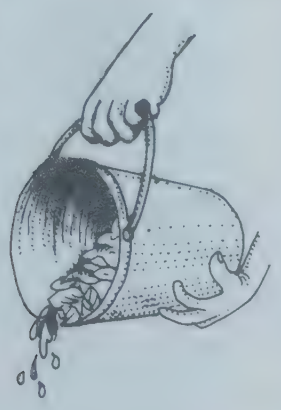
Waste paper from old notebooks, used, unwanted office stationary, old newspapers, etc., could all be used to prepare recycled paper. Students could collect used paper from different classes, school offices, library, etc., as well as use paper that

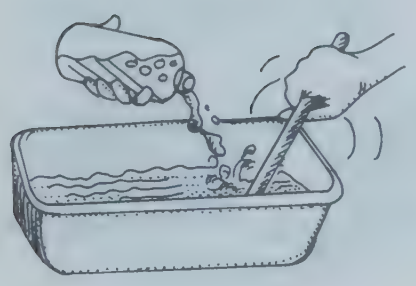
Compost Pit

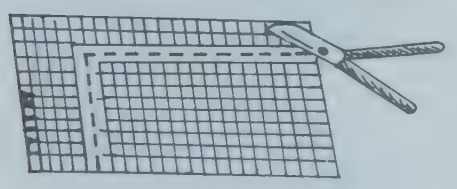
- Let the students dig a pit about one half m wide, one m deep and as long as possible, preferably at the far end of the garden.
- Line it with straw or dried leaves and grass
- Organize the disposal of organic waste into the pit as and when generated.
- Give a group of students the responsibility to ensure that the contents are covered with a sprinkling of dried leaves and soil everyday.
- Water the pit once or twice a week to keep it moist.
- Turn the contents of the pit every 15 days.
- Compost manure will be ready in three to four months.

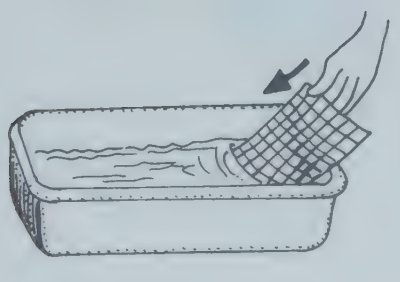


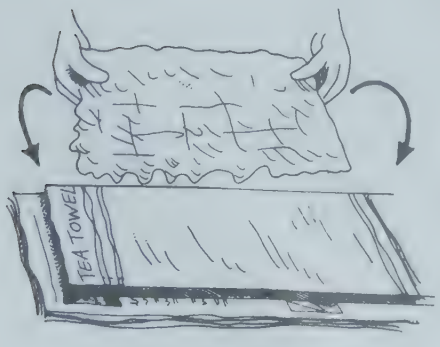












would have accumulated in the dustbins during the collection and segregation step. Paper bags, wrappings, paper notices, etc. may also be collected from home.

Requirements: Waste paper (old newspaper, waste paper from school and offices, paper that comes with packages, etc.), very fine wire (or plastic) mesh, absorbent cloth (old towels), large plastic buckets or bowls or basins, wooden spoon, colour (optional, to give colour to the paper), plastic bags, weights, etc.

Ask the students to:

- Shred the paper into half-inch pieces and put in a bucket of water.
- Let it soak overnight.
- Drain off excess water and using the wooden spoon, mash the paper into pulp.
- Cut the mesh to the size of paper required.
- Put the pulp in a basin (the basin should be able to accommodate the mesh) and add equal volume of water and mix well. (Increasing or decreasing the amount of water will affect the thickness of recycled paper. For example, if there is more water in the pulp, then it will spread more easily and the paper will be thinner.)
- Slide the mesh into the basin and move it around in the basin until it is evenly covered with pulp. Lift out the mesh which is now covered with a layer of pulp.
- Place the mesh over an empty basin for at least one minute so that the excess water in the pulp drips off.
- Place the mesh with the pulp side up on a towel or blotter which is placed on some old newspapers.
- Place another towel or blotter over the pulp and cover it with another old newspaper.
- Roll a rolling pin over the sandwiched pulp to squeeze out as much water as possible.
- Remove the top newspaper and then turn the blotter-sandwich over, so that the mesh is on top.
- Remove the blotter and mesh very carefully (a butter knife may help). The pulp should not be disturbed.
- Allow the pulp to dry for a day or two.
- When the recycled paper is dry, neatly trim the edges.

Modifications

- Leaves may be placed on the last layer of the newspaper that is placed over the pulp to make patterns on the paper.
- Coloured paper is made by adding liquid dye made from plant materials such as bark, fruits, petals, etc., while mashing the paper into pulp.
- Scented paper is made by adding a small amount of perfume or natural scents (lavender, mint, etc.).

Re-use of Plastics

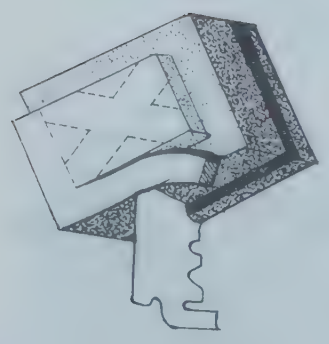
Plastics are difficult to recycle, as this process involves high temperatures and may emit gases which could be harmful if proper precautions are not taken. Even then, it is only possible for plastics of a similar kind to be recycled together. It is recommended that the students re-use the collected plastics. Different kinds of plastics could be segregated and sold to the *kabadiwallah* as well.

Some of the plastics which are used in day-to-day life could easily be reused. Here are some ideas to get the students started:

- Thick polythene, as used in milk pouches, could be made into bigger bags. Slit milk bags on two sides to make a sheet of polythene. Wash the bags with warm water and detergent. Stitch these sheets together to make bags with handles. The stitching can be done with a sewing machine if available, or needle and thread, although this may not be as sturdy as machine stitching. Such sheets may also be used for covering books, to make large covers to protect school bags from rain, etc.
- Thinner polythene bags could be shredded and used to fill rag dolls, if such an activity is carried out in the craft classes.
- Thicker and larger polythene could be stitched together and used to cover things kept outside (implements, cycle, etc.)

Craft from Waste

Many things which we consider as beyond use, e.g. worn out slippers, socks, plastic boxes, etc. could still be useful to make different craft items. These items can also be displayed in an exhibition on garbage, often organized as part of the clean-up campaigns. Some ideas for using waste material in crafts are given on the following pages.



Slipper Stamp

Students could make rubber stamps from used slippers.

Requirements: An old rubber slipper, a shaving blade or medical/surgical blade, water colours, ink or stamp pad.

- Cut a piece out of the less worn out and even part of the slipper.
- Wash the piece thoroughly with soap and water.
- Draw the outline of the mirror image of the letters or design you want.
- Use a blade or knife to first cut a groove along the outline. Then cut away the part outside the outline in such a way that the design outlined is slightly raised above the rest of the piece. Only the part to be used as the stamp should be raised. The rest should be cut out.
- Apply some colour or ink on this raised part (you could also use a stamp pad) and put your personal stamp on letters, your books, etc. Designs which are too complex to carve should be avoided. To begin with, use straight lines and simple forms.

Paper Dish

Old newspaper, note paper, etc. could be used to make small plates, dishes, etc.

Requirements: Used paper (preferably of uniform thickness), gum, petroleum jelly, a shallow metal dish.

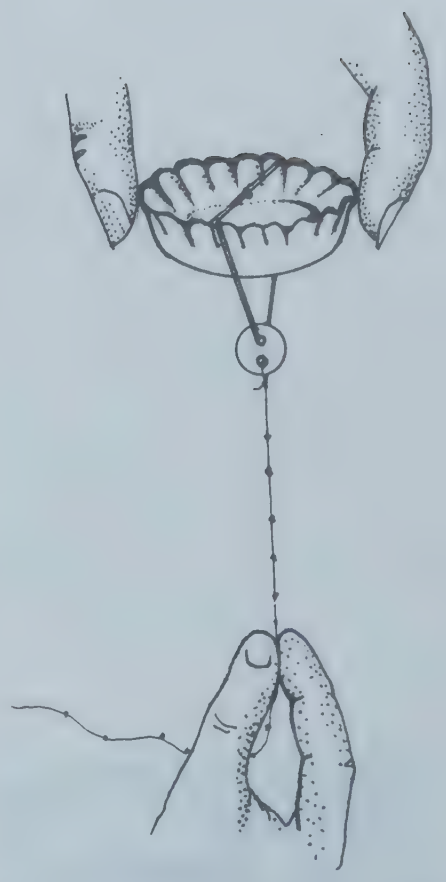
- Apply petroleum jelly on the back of the metal dish.
- Tear the paper into small bits and soak in water for about five minutes.
- Place the pieces of wet paper on the greased surface, making a layer of wet pieces of paper on the dish.
- Apply gum on this layer and then put another layer of paper on the first one.
- Make about four layers in this manner.
- Let the dish dry.
- After it is completely dry, carefully lift off the paper plate from the metal dish (use a knife if necessary).
- This could be decorated using water-colours and used to keep dry foodstuff or small things like paper clips, pins, etc.

Chirping Insect

Soft drink bottle caps, buttons, etc., could be used to produce the sound of a chirping insect.

Requirements: Soft drink bottle caps, buttons with two or four holes, rubber bands, kite flying string.

- Put the string through one of the holes of the button.
- Make knots at one inch intervals on the string.
- Through the opposite hole of the button, put one end of a rubber band. Knot the two ends together.
- Stretch the rubber band over a bottle cap.
- Arrange the button so that it is located exactly at the center of the cap.
- Hold the bottle cap between two fingers of your left hand. Take the knotted string loosely between the fingers of your right hand.
- Slowly pull the knotted string through the fingers, so that each knot passes through the fingers. This will produce a "tick tick" sound.

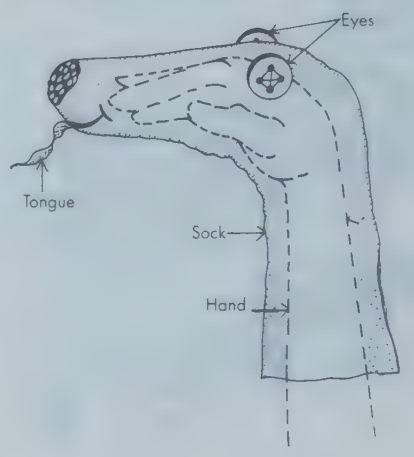


Sock Snake

Old socks may be converted to sock snakes.

Requirements: One or two old socks, needle and thread, buttons, bits of old cloth.

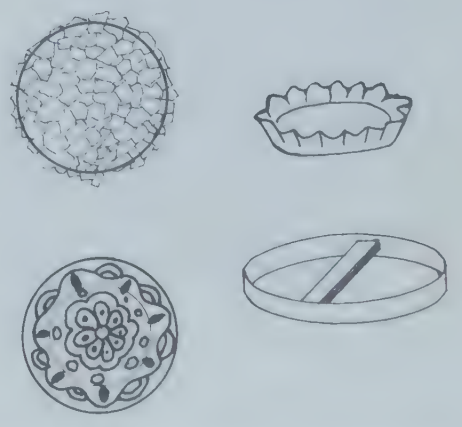
- Put an old sock over your hand. Imagine it is the head of a snake and mark the position of eyes and mouth.
- For eyes, stitch two buttons on the sock.
- In a distinct colour, stitch a line for the mouth. Attach a strip of cloth as a tongue.
- Stuff the sock with rags so that it retains some stiffness and shape.
- Stitch the open end of the sock



Badge

Requirements: Lid of a small plastic box, thin bamboo stick, paper, sketch pens, pictures.

- Cut the bamboo stick to the size of the inner diameter of the plastic lid.
- Place the lid on the upper edge of your shirt pocket.
- From the inside layer of the pocket, push the stick so that it fits the inside rim of the lid. Your badge will stay in place.



- Decorate your badge with your own painting/drawing, a picture you have cut out with a slogan or message you would like to express.

Here are some more ideas on using waste for craft activities

- Unusable plastic bottles could be made into containers for pencils: cut off the top of the bottle and paint on the lower part of it or paste coloured paper over it.
- Cartons could be used to make bird houses, feeding boxes for birds, etc.

Source: Craft Activities—Wilson Solanki, CEE

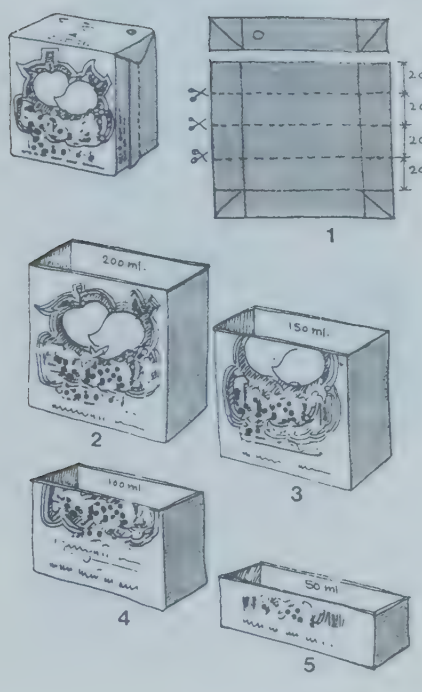
Multi-use Packs

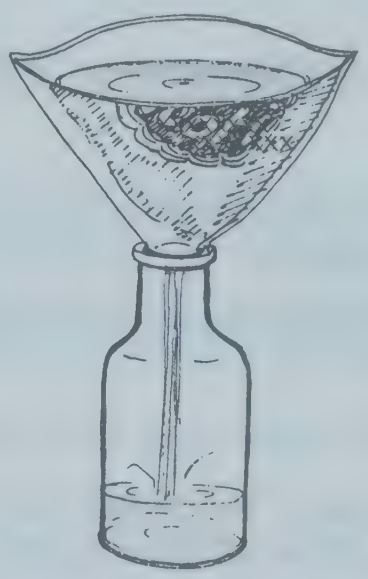
Tetrapacks have become a part of our lives. We bring them home when we buy oil, or a soft drink. And then we throw away the pack. This kind of packaging is expensive and it is not biodegradable. It is also not easy to recycle, as it is made of layers of different materials like plastic, aluminium and paper which are fused together to make a single sheet, and thus not easy to separate.

While the effort must focus on reducing their use, with ingenuity, tetrapacks could be made into useful articles. A fruit drink tetra-packet, when flattened and cut across the diagonal and right lower corner, transforms into a handy funnel for pouring kerosene, oil, etc. An open fruit drink tetra-packet could also be used as a handy glass on journeys. Whether a funnel or glass, they are easy to be flattened neatly for storage until the next use.

Students could also make measuring cylinders for use in experiments. Flatten out a used fruit drink tetra packet and cut off its top lid. Reshape the pack into a box. This container which is eight cm high has a capacity of approximately 200 ml, and becomes a handy measuring cylinder that every student could make and keep.

Source: Arvind Gupta, New Delhi





Pools of Stagnant Water

Pools of stagnant water usually occur after the rains, especially wherever the ground is uneven, and become a breeding ground for mosquitoes which may be carriers of dangerous diseases such as malaria or dengue fever. Students could take up a project to tackle this problem.

Determine from a survey of the school grounds or surrounding areas, which places have a tendency to accumulate water, and find out why this is happening. There may be two ways of dealing with the problem: levelling the ground, or diverting the water.

1. Levelling the ground to avoid pockets where water may collect:

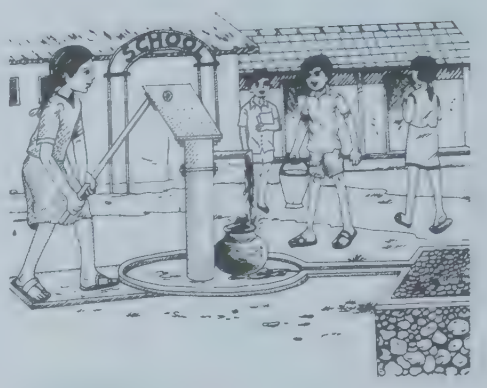
   The students can dig up soil from one area, transport it and spread it on to low-lying areas. Preferably, this should be done before the rains, so as to avoid water stagnation during and after the rains. Students would need spades to dig, and containers to transport soil; both may be obtained from gardeners.

2. Making canals to divert accumulated water, and channelling it to be used for watering plants, etc.

   This may be done not only during the rainy season, but also if there is a continuous accumulation of water at any spot (e.g. near the drinking water area, or a tap in the school compound). If such a system of diverting water is applied to waste water from wash basins or drinking water taps, a use for waste water would be created and the surrounding areas will remain dry and clean.

The students could dig a canal from the low-lying area, where there is a possibility of water accumulation and stagnation, to a nearby garden plot. If such a place does not exist, then the students could plant some seasonal flowering plants or vegetables where the water is being diverted.

In the process, the students involved could also make sure that there is no unnecessary wastage of water from leaky taps, either by bringing it to the notice of the concerned person in the school or if possible, repairing the tap themselves.



Sharing the Experience

The students could present a weekly or once in a term report about their clean-up campaign and recycling activities, providing details about the material they collected, the funds collected by selling 'waste', and any other related matters. This would not only inform the others about the group's activity, but may also infuse interest and encourage them to participate.

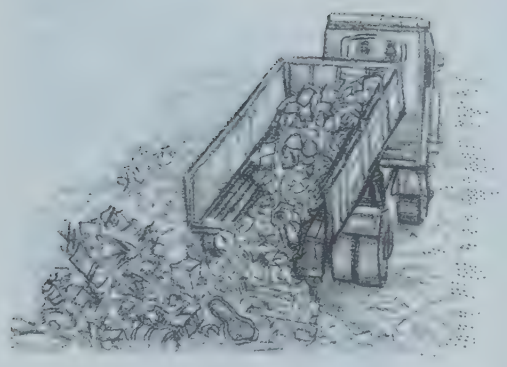
Outside the School

Introducing Solid Waste Management

Outside the school, the students could take up a project to create awareness among people in a selected locality about the need for segregation and proper disposal of garbage and plan a system for better management of garbage. The students planning a community-based project could follow the following steps:

Preparatory Work

They could choose a community through a general survey of the neighbourhood and by determining which areas are plagued with improper disposal of waste, and through discussions with the Society in-charge e.g., secretary of the Co-operative Housing Society, or the person in-charge of the Welfare Association, etc. After this discussion, the students should meet the residents, as a group or individually, to explain their interest in doing a cleaning up project in the area and request the community to render support to the programme.



Investigating Quantity and Type of Household Waste

Once the students have identified the community and have approached them about initiating a garbage awareness and management programme, they should do a household survey in the community to find out the different kinds of waste and the quantity of the same generated in the homes.

Household Survey Sheet

1. Location of household (address):
2. Is there accumulation of garbage in and around the place?
3. Who is responsible for dumping the garbage in the neighbourhood?
4. Is there a Municipal Corporation dustbin?
5. Does the Municipal Corporation collect garbage from these areas? If not, who is responsible for this?
6. If so, how often?
7. Do the residents dispose of their garbage themselves, or do they employ someone to do the job?

The students should find out whether the residents practice any kind of recycling in their homes and what kind of waste is disposed. They could also survey the disposal systems in and around the households, and talk with the residents to collect information on the existing garbage disposal/management systems.

The following survey sheet could be useful to record and compile such data. Each household may be requested to keep records for three to four days.

Glass, cans, etc., may be counted by number of items; paper by number of pieces or sheets; kitchen waste may need to be weighed or measured in a standard measure, e.g. cup or pan.

Day	*Paper*	*Glass*	*Aluminium/ Tin foil*	*Kitchen Waste*	*Plastic*	*Other: Batteries, etc.*
Mon						
Tue						
Wed						
Thu						
Fri						
Sat						
Sun						

Setting the Objective

Once the students discuss and analyse the garbage related problems of the community and the reasons which have led to garbage dumping in a particular place, they can then decide how to tackle the problem. Depending on the need, the students could set the objectives of their project, which may be:

- creating awareness among people in the selected areas about the need for segregation of garbage as a step to efficiently manage garbage in their neighbourhood.
- creating awareness among people about the need for citizens' participation in the management of garbage in their neighbourhood.
- planning and implementing a segregation programme with the community.
- liaisoning the Municipal authorities and bringing to their notice the situation in the concerned area; liaisoning with NGOs for garbage management, etc.

Staying Clean

An effective clean-up activity cannot be a "one-time" or "once in a while" activity. A plan for sustained action is necessary. In any community programme, it is necessary to plan the initiative such that representatives from the community take charge to ensure effective functioning of this system.

Convincing the Community

Creating awareness about garbage management is usually a key link in any garbage related programme. The students could begin such an awareness programme by some activities which would serve to inform the residents about the advantages of segregation of waste and its proper disposal. They could accomplish this through a presentation, posters, skits/dramas, door to door campaign, etc. The following points could be covered:

- what happens to the different kinds of waste generated?
- how different kinds of waste materials can be recycled,
- advantages of segregation, and
- the need to reduce waste.

They could use the facts provided in the previous section to stress their points.

They could hold a meeting with the residents in the community. They should announce this meeting well in advance, providing details about the venue, date, time, etc.

They could stage puppet shows or plays, or display posters at the beginning of the meeting. This could be followed by a presentation on the problem of garbage and possible solutions, using aids like information charts and posters. They could also give examples of how community efforts have helped make cleanliness campaigns a success in other areas. This could include case studies such as how garbage mounds would lead to the perpetuation of rats and other disease carriers—the example Surat, Gujarat, which experienced an epidemic of plague a few years ago, and how this city has become one of the cleanest in India.

Once this is done, they could inform the group about the programme on hand. They can also invite representatives from the Municipal Corporation and other organizations involved in collecting segregated waste.

They could collectively decide how the residents would segregate the waste in their houses. If enough funds are available, the residents could be provided with different bags for different kinds of waste. Fixed timings should be set up for rag-pickers to come and collect the waste.

The concept of composting organic waste could be explained and if each house does not have place to make a compost pit, they could set up models where households could compost in a large flower pot. Alternatively, the idea of a community compost pit may be thought of.

Stagnant Pools

The students may find places in the neighbourhood or a locality, where there are stagnant pools of water.

Some of the ways in which students could work with the community to avoid stagnant pools of water becoming a breeding ground for mosquitoes include:

- If there is a stagnant pool of water in the neighbourhood, it can either be filled with soil, if the water cannot be used otherwise, for example for watering plants.
- If a large number of stagnant pools of water are found, especially immediately after the rains, one reason could be that the storm drains need to be cleaned. This could be done with the help of the local cleaners; or the students could write to or approach the Municipal Corporation authorities, and request them to do the needful. They could also write to the newspapers about the conditions in the area.

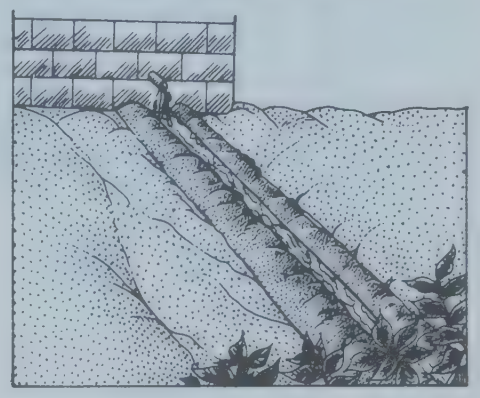
The areas near taps and hand pumps are also places where mosquitoes proliferate. The students could help prevent stagnation of water at such places by diverting the water to nearby gardens. They could also plant flowering plants in the vicinity to make use of this waste water.

Students, with the help of the community, could also make simple soakage pits.

They could also work with the community to encourage them to cement the immediate area around the hand pump/tap and then divert the water through small canals to the fields/gardens.

They could share information with those who come to collect water and ask them to avoid unnecessary wastage of water, about the hazards of water stagnation, and also diseases that could spread by the flies, mosquitoes, etc., that breed in such places.

Waste water diverted to Kitchen Garden



Maintaining a Local Water Source

The students could survey the proposed project area to find out sources of water in a community. They could prepare a map giving details about:

- location of the water sources,
- location of the residences, the fields and/or factories, etc.,
- whether there are any landfills, garbage dumps, etc.,
- whether there are any sources of water contamination from surface runoffs or through ground water contamination.

After this investigation, they could take appropriate action to improve the situation. For example:

- If there is a local well or a tank that is dirty, or the water is polluted or contaminated, the students could initiate a campaign to improve the situation. If there is an open well, they could try to get it covered by talking/writing to the Panchayat or Municipal Corporation authority, collecting funds from the community members, etc. The latter would ensure that the community feels responsible towards the maintenance of the well.
- They could also introduce fish, such as Gambusia, which eat mosquito larvae into open tanks or ponds.
- If they find that discharges from factories are contaminating the water body, then they could build public pressure through organizing rallies, writing to newspapers, approaching the authorities with letters signed by community members, etc., so that the factory takes necessary action.
- If there is run-off from agricultural fields which use chemicals like fertilizers, pesticides, etc., which may be causing water contamination, then the students could inform the community members and then collectively devise ways to prevent it. They could construct canals around the fields to divert the run-off water from contaminating the water body. Students could also attempt to influence farmers in the area to use bio-fertilizers and non-chemical methods of pest control.

Guarding Against Water Waste

Students could work towards reducing waste of water in public places, by ensuring that the taps are not leaking at common stand posts. If they are found to be leaking, this situation should be brought to the notice of the authorities, the person in-charge or the residents, for immediate repair.

They may use various media to create awareness among the community members about the need to conserve water.

Building a Simple Soakage Pit

A soakage pit is a pit filled with different sizes of stones or broken bricks, through which the waste water filters down and is soaked into the ground. This not only avoids water stagnation but also helps in water percolation.

Soakage pits bricks may be acquired from construction sites. Students should get prior permission from those in-charge of the construction site. The stone fillings prevent the pit walls from collapsing. As the waste water flows into the pit, it gradually seeps into the ground.

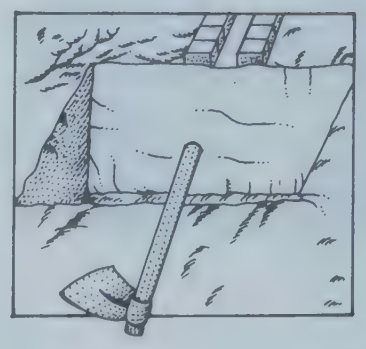
Such pits may be built near a place where there are high chances of water wastage from nearby water pumps, drinking water or washing areas.

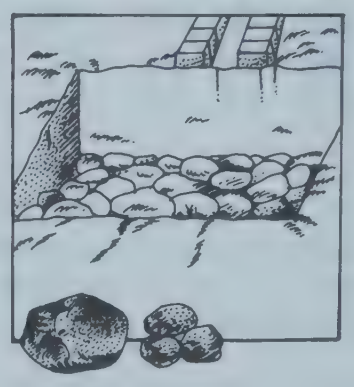
Requirements: Stones of different sizes (~10-15cm; 5-10cm; and 1cm in diameter), a small pot (~20cm in diameter), gunny bag, coconut fibres, etc.

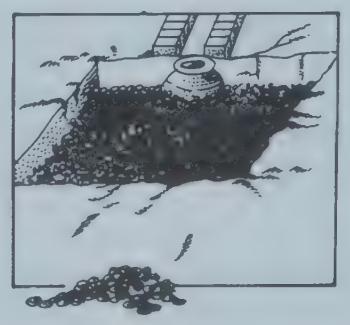
Ask the students to:

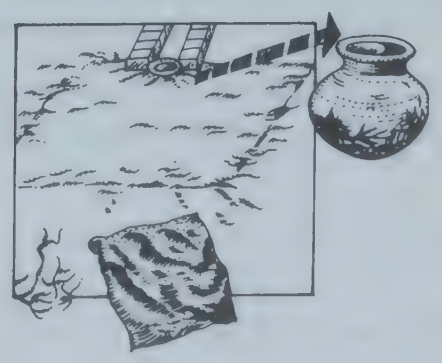
- make a channel from the place of water wastage to the place where the soakage pit is to be constructed.
- dig a pit of approximately 1m x 1m x 1m at the end of the channel.
- fill the pit up to one-third of its depth with large stones (approx.10-15 cm in diameter). This should be followed by smaller stones (approx. 5-10 cm in diameter) filled up to two-thirds depth.
- place a small (approx. 20 cm diameter) clay pot with small holes (approx. 2 cm in diameter), at the outlet of the channel. Coconut fibre/leaves can be placed inside the pot to trap the sediments. Then fill the pit with still smaller stones (approx. 1 cm in diameter) up to a level of 10 cm below the ground level.
- place a 5 cm layer of twigs followed by a gunny bag. Place soil on top of the gunny bag and compact it to ground level.
- the sediments in the pot should be removed regularly and fresh coconut fibre or leaves added.
- when the soakage pit gets clogged up (after a few years), it has to be emptied and the stones washed, dried and replaced.

Source: "Let us Promote Sanitation"—UNICEF , New Delhi, 1988.









Adopting a Local Monument

The students could "adopt" a nearby historical monument or cultural heritage site, with the permission of the relevant authority, e.g. state offices of Archeological Survey of India, and work towards keeping it clean.

To begin with, students could improve their knowledge about the monuments by studying the monument carefully, collecting information from various sources such as guides, knowledgeable persons in the community, historians in a nearby university or people who have studied the monument in great detail. They could then compile their findings into posters, pamphlets or booklets to distribute to the visitors, local schools, communities, etc. They can also put up informational signages with permission from the authorities.

The students could campaign against the various forces that are leading to the deterioration of the monument, by informing the concerned authorities about any activity which is contributing to this. Attempts may be made to prevent such actions, for instance, preparing and placing placards at strategic positions with captions discouraging graffiti, spitting, littering, etc.; placing labeled dustbins with a caption asking the visitors to use them; organizing rallies near these sites, etc.

They could initiate an awareness campaign in the locality so as to involve the local people in this project.

The students could clear the area around the monument and plant and maintain a small garden.

Outcomes

Such clean-up projects provide students a chance to organize and conduct activities which show immediate effects. They involve children working outside their schools or homes, which would give them an idea of community based work, co-operation with other students and the public, etc., and generate a greater sense of involvement in the neighbourhood and community. Another positive outcome is of course cleaner surroundings in the school and neighbourhood. As a teacher, the educational and other outcomes are:

- These projects involve students in keeping the school or neighbourhood clean and such involvement would help students to become active learners and apply their classroom skills to solving real problems.
- The hands-on experience would encourage students to include the three 'Rs'— reduce, reuse and recycle —as part of their lifestyle, not only at school but also at home, and at every stage in their life.

- If the programme involves the neighbouring community, then such a programme would help to strengthen the relationship between the school and the community.
- Recycling programmes may also generate funds for the school. Old papers and notebooks could be sold to the *kabadiwallah* and the funds thus collected may be used for school activities.
- Recycled crafts made by the students could also be sold during school fairs or any other occasions, including a special sale of recycled materials, if the programme generates enough materials.

Such projects could be continued year after year, by different sets of students in different areas. Wherever a certain level of awareness has been achieved, the students should keep track so that the activities are continued and the momentum is not lost.

Kids Did It!

The students of Class VIII Sardar Patel Vidyalaya, New Delhi, took up a project to study an unknown monument near the students' houses. The objectives were to make history more exciting; to appreciate our heritage; to research, interview and develop specific skills like mapping, designing, etc.; to think and do something about the environment in a constructive way. The focus was on protection and preservation of our national heritage and to draw the attention of the students to the condition of hundreds of monuments scattered around Delhi—neglected, unprotected and unwanted.

A detailed project outline paper with instructions and suggested activities was given and the project was carried out by groups of four children. The project was completed in a month's time.

Before the work on the project began, a slide show on Delhi and one of the cities of Delhi, Jahanpanha, was shown.

Apart from studying the chosen monuments from inside and outside, the students visited the Archeological Survey of India (ASI) to do further research. Most of the structures were in ruins and even the ASI had no records and little information. Unearthing of information became a great challenge to the ingenuity of the students. They interviewed the caretakers of the monuments, and people who lived in the area.

One student did the detailed study of one of the monuments, including maps and suggestions for cleaning up the area and for its protection and preservation. In a lighter vein, a student made a maze puzzle for uncaring officials, so that at least they could grope their way to the monument and have a look.

Students took photographs, especially of the ugly modern carvings and inscriptions. They compared old monuments with modern ones, such as India Gate, and discussed if such monuments would be worth building today.

As a teacher, I was heartened by their response. I felt that it is through such studies undertaken by students at an impressionable age that awareness can be created and that vandalism against monuments, public property, wildlife and forests, could be stopped in the future.

The students as a group were given marks for their projects which were included in their semester exams. The projects were exhibited so that the whole school could look at them, and are presently kept in the school library.

Source: Chitra Srinivas, Sardar Patel Vidyalaya, New Delhi

WASTE NOT

- The amount of fresh water available for human use directly is less than one per cent of all the water on this planet.
- India has the second highest average annual rainfall in the world, but we still face water shortage.
- At the current rate of fossil fuel consumption, the present oil reserves on the earth will last only for the next 30-50 years.
- Crores of rupees are being spent to extract, process and distribute coal, petroleum and electricity.
- Automobiles, apart from depleting our limited amounts of oil, emit exhaust fumes which contain nitrogen oxides, carbon monoxide and other gases, leading to air pollution. These are also considered to be responsible for the occurrence of acid rain.
- Smoke from burning fuels and oil rigs comprises a mixture of soot and acid gases which causes global warming and is also responsible for climatic changes.
- Energy for cooking food consumes half of all the energy produced in India. 90 per cent of the country's energy requirement in this area is obtained from noncommercial sources.

Photo: Madhavi Joshi

One way of conserving renewable and non-renewable resources and reducing the pollution resulting from their use, is through reducing wasteful consumption. Prevention of waste involves developing an awareness and a sense of responsibility towards resources. Students could take up projects which would help them to realize ways in which resources are wasted and learn about ways to reduce the same, and ultimately to practice these in their daily life.

As in the action projects discussed earlier, projects on reducing and preventing waste must also be planned and implemented in a systematic fashion. Whatever the nature of the project, the six steps given below will help guide the process.

1. Introduction to the issue
2. Survey
3. Deciding on the action plan
4. Involving others
5. Taking action
6. Evaluation

In addition, some special points will have to be considered when planning and carrying out such projects.

Since these programmes may involve a number of surveys followed by analysis, the teacher would need to brief students about simple survey methods.

Inclusion of field trips such as a visit to a power station/sub-station, a farm where water conserving irrigation methods are practiced, a community using alternative sources of energy, like solar energy, solar cookers, bio-gas plant, etc. would help students to put their project in perspective and relate it to real life.

While interacting with the community, the students should first try to get to know traditional practices, if any, which reduce waste generation, e.g., reuse, use of alternative technology or customs which prohibit wastage, e.g., the belief that wasting of food is a sin.

Students could take up projects to create awareness about waste and take steps to reduce or prevent waste in several areas: water, electricity, fuel, paper, etc. There are different ways in which these projects can be organized.

- One class could take up a single project for one year, for example, on reducing wastage of water.
- One class could take up more than one project during a one year period.
- The class may be divided into two or three groups of six to eight students, with each group taking up a different project.
- Different classes could take up different projects to stop or reduce waste.
- The teachers could utilize the SUPW period for this project.
- Surveys and other such activities could be done during the holidays.

The following pages describe some ideas for such projects.

Water

Availability of clean water contributes greatly to the quality of life. When this resource is readily available, the tendency is to use it wastefully, without realizing its priceless value.

Students could take up projects which would lead them to become aware of how they use and misuse water and teach them simple actions they could take to conserve it.

Understanding the Issue

One fact that students have been told over and again is that water is precious, and that there is a very limited quantity of fresh water available for use. Even with this knowledge, many people tend to waste water. It is therefore recommended to reinforce this concept before students take up a water conservation project.

This could be done through talks, slide shows, videos and charts that graphically demonstrate the distribution of water on earth. Students should also be made aware of the fact that water is used for human consumption, as well as for agriculture and industrial uses.

Once they have understood how limited and therefore precious water is, they may look around and find out whether and how it is being wasted.

Survey

To get an idea of the general situation, students may conduct a daily survey over a period of about a week, to find out where, how and why water is being wasted in the school. The survey sheet given below suggests some basic points about which information can be collected.

School Water Survey No. 1

1. Source of water:
   Bore well/Municipal supply/Taps/Hand-pump/Other
2. Water is stored in (tanks, *matkas*, coolers):
3. No. of taps/*matkas* in the school (including garden, kitchen, coolers, toilets, labs, etc.):
4. Are they properly covered?
5. No. of taps left open/leaking:
6. How much water is wasted by the leaking taps in a one month period?
   (An activity similar to "Counting Every Drop" may be done to estimate this)
7. Who are the persons, other than students and teachers, using water in the school.
   (gardeners, cooks, sweepers, etc.):
8. Who is the in-charge of the pump-house?
9. How many times does he/she start the pump in a day?
10. Note the water bill for the last three months:

Deciding on the Action Plan

After the survey, the students can compile their findings and attempt to analyze the nature of the problem. For example, were the taps dripping because they had not been closed properly, or because the washers had worn out, or due to some other reason? Once the situation is understood, they could begin a campaign to help others in the school also become aware of the problem, through posters providing details of their survey (specifying the magnitude of the waste, causes and consequences of water loss, electricity bills for pumping, etc.).

It is also important to devise practical ways to improve the situation. Some possible actions include:

- For the leaking taps, students could contact the relevant person in-charge in the school or the principal, and discuss the findings of the survey with them, requesting that the problem be addressed. They may write an application requesting the principal to do the needful–either change the taps or repair them, and ensure, by repeatedly checking, that the problem is rectified.
- If there is unavoidable wastage of water, for example, near the drinking area or washing area, students could make efforts to use this water for irrigating plants. To divert the water, a canal, lined with clay or bricks to prevent its collapse over a period of time, could be dug from these areas to the garden.
- If stored water is left uncovered, students must ensure it is covered. For water stored in *matkas,* the students could design a lid made out of cardboard. For water stored in tanks, they could bring it to the notice of the authorities. Students should also make sure that the tank is cleaned regularly.

Once the authorities and other school members have responded with some positive action, the students must continue to monitor to ensure that the activity is sustained.

After a month/term, students should do a survey again to find out the extent of improvement in the situation.

School Water Survey No. 2

No. of taps left open during the first survey:

No. of taps left open now:

No. of leaking taps during the first survey:

No. of taps that are leaking now:

No. of leaking taps that have been repaired:

Amount of the water bill after the campaign:

Counting Every Drop

This activity helps to demonstrate how much water is wasted as a result of a single leaking tap.

Materials required: Measuring cylinder, stop watch or hour glass, leaking tap (either genuine or set up).

Students can discover how much water is lost from a dripping tap by placing a measuring cylinder or a container under the tap for one minute, and then measuring the water that has collected in the measuring cylinder. For example, the amount of water collected from a dripping tap in one minute may be 50 ml. Now the students calculate the amount of water that would be wasted in one hour (50 ml x 60 minutes = 3000 ml or 3 l), and also in one day (3000 ml x 24 hours = 72,000 ml or 72 l or approximately three buckets), from a single dripping tap.

If 72 litres of water is wasted from one leaking tap in one day, then students could calculate the amount of water wasted by the total number of leaking taps in the school in a day, in a week and in a month.

Tips for Water Watchers

- When you turn on the tap, don't turn it the whole way—maintain a slow flow.
- Turn the tap off while you brush your teeth or wash your face.
- Ensure that the tap is closed when clothes are being washed or vessels cleaned.
- Fix leaking taps as a priority.
- When you fill a glass of drinking water, take only as much as you will use.
- For a cool bath during summer, don't let the water run until the flow is cold; fill a bucket of water and let it stand for a few hours.
- If you store water in the house, utilize the unused stored water for soaking clothes, watering the garden, mopping the floors, etc.
- Wash vegetables, fruits, etc. in a pan of water, rather than under running water.
- Keep a large bucket in the kitchen and pour water used for washing food items or rinsing vessels into this. This could be used for watering plants.
- Collect and store as much rain-water as possible during the rainy season. Rain-water is pure, and apart from washing and bathing, you could use it for watering delicate plants. Brass vessels washed with rain-water stay sparkling for a long time.
- Water the garden early in the morning or late in the evening. This reduces water loss due to evaporation. Avoid the temptation to over-water the garden and water only until the soil becomes moist, not soggy.
- Use defrost water from the refrigerator for watering delicate plants, after it has warmed to room temperature.

Students may tabulate this data along with the that of School Survey Sheet No. 1. The findings could also be displayed on the notice board to help others realize how even small steps could help to conserve precious water.

A similar survey could be conducted at home also. The students would need to move around in their homes to find out the basic data.

Home Water Survey Sheet

(Students may take assistance from parents if needed)

(1 mug = 425 ml) (1 bucket = 20 litres)

(If the student is using two mugs of water for washing hands, then s/he is using 2 x 425 ml of water. In this way, the students could determine the amount of water used for the following.)

Estimation of amount of water used in a day:

Activity	*How much water is used by:*				
	Mother	*Father*	*Brother/ Sister*	*Self*	*Others*
Cleaning teeth					
Bathing					
Drinking					
Watering plants					
Cleaning					
Cooking					
Washing					
Total					

This survey could be done on a holiday. Based on this, students can calculate the average amount of water used by each member of the family, as well as the total amount of water used at home in a single day. Students would notice a difference in the quantity of water used by each person. Let them decide which member of the household is most wasteful, and who is the conserver of water. Students can convince the family to adopt practices which avoid needless waste of water.

Students, in groups, may also expand the survey to cover a selected residential area.

Neighbourhood Water Survey

1. Type of house (flat, bungalow, row house, etc.):
2. No. of persons in the house:
3. Name with full address of the respondent:
4. Source of water:
5. Time during which water is supplied by Municipal Corporation:
6. Storage facility (mention the type and capacity):
7. Do they have water filters?
8. Details of water usage: (to be measured in buckets of standard size 11, 16, or 20 l)

Usage	*Quantity*	*Remarks*
1. Cleaning		
2. Cooking (including drinking)		
3. Washing (including washing clothes, utensils, house, etc.)		
4. Bathing (including brushing teeth)		
5. Sanitation		
6. Gardening		
7. Any other		
Total (in litres):		
Quantity of water used per person per day:		
Total quantity of water used:		
No. of persons in the house:		

General remarks (particularly about quality of water and water usage pattern):

Date:

Signature of interviewer Signature of respondent

Other Aspects of Water Use

Students could also find out about the traditional methods of water harvesting and storage, and where possible, make efforts to use these methods.

Water Harvesting

Rain-water harvesting has been practiced in Indian villages from time immemorial. This involves conserving rain-water at the place where it falls. How it is done depends on the local needs and the nature of the land. In this process, ground water is also recharged. These traditions, especially those that are community based, are strongest in areas of low rainfall and undulating land surfaces.

Tankas (or underground tanks for drinking water) in Rajasthan are found in most traditional Bikaner houses. These consist of circular holes made in the ground, lined with fine polished lime, in which water is collected during rainfall, and used only when other supplies failed. These are often beautifully decorated. They include a tiled cover which helps to keep the water cool.

Rooftop harvesting is common across the towns and villages of the Thar in Rajasthan. Rain-water that falls from sloping roofs of houses is collected through a pipe into an underground *tanka*, built in the main house or in the courtyard.

The stepwell is a unique method of water harvesting found in Rajasthan and Gujarat. A long-stepped corridor leading down five to six storeys to the well is an essential feature of the stepwell. Traditional water harvesting systems have passed the test of time and are suited to the specific environments for which they have been evolved.

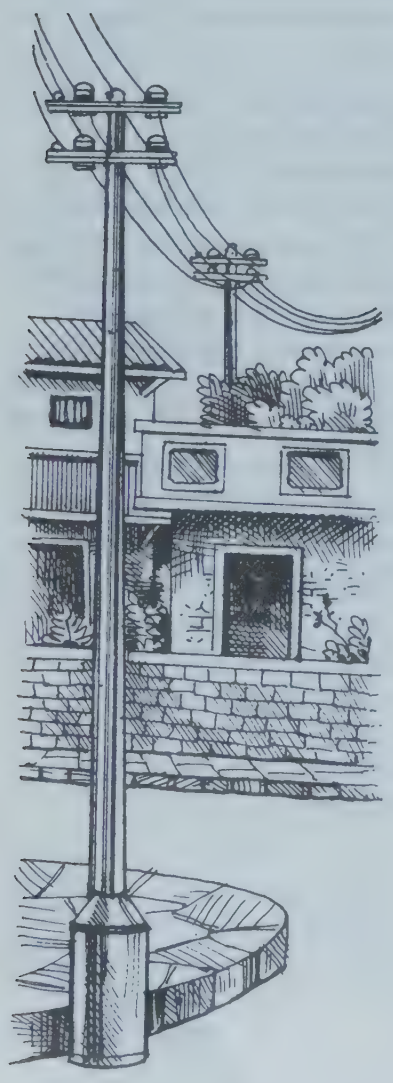
Source: Dying Wisdom—Fourth Citizen's Report: Centre for Science and Environment, New Delhi, 1997

Adding Up

This activity is a demonstration of measurement of the differing electricity consumption of different appliances and how the use is converted into meter readings.

Materials required: Electricity meter, an appliance that consumes a great deal of electricity, e.g. an electric oven or immersion water heater, and an appliance that consumes comparatively less electricity, such as a tube light or a radio.

These appliances may be plugged in and switched on, one after another, for the same duration, e.g. five minutes each. Students in small groups can note the meter readings before and after each appliance is used. They can find out how much the meter 'runs' for each gadget, and from which the units and eventually the bill can be calculated.



Electricity

Electricity has made our life comfortable and we are becoming more and more dependent on gadgets of all sorts—for daily chores as well as for entertainment. Students hardly realize that the increasing use of electricity has a price, not only in terms of paying the bills, but also the impact this has on the environment. Through this project students find out about the use of electricity for various purposes. They get to know how to conserve electricity and the importance of the inculcation of simple conservation habits, in making a marked difference.

Understanding the Issue

The students can be introduced to the topic through:

- A talk by a resource person, (for example an official from the electricity board), on production, uses and conservation of electricity. The problem of limited fossil fuels and also the problems caused by dams and nuclear fuels should also be discussed.

- A field trip could be arranged to a nearby power sub-station where the officer/engineer/in-charge could provide students the details about how they receive electricity in their school/ locality (i.e. generation in thermal/hydro/nuclear power station, the transmission to main station to sub-station to home or school) and the environmental consequences of electricity generation.

Students should also be familiarized with an electricity bill. They should study what kind of information is found on the bill, and discuss what each head means.

Survey

Once students have been introduced to the system of recording and billing electricity use, they could conduct a survey to find out where and through which appliances electricity is used in the school. They may use the survey sheet given on page 53, and add to it other items that are specific to their situation, e.g. use of pump for pumping water up to the overhead tanks.

The survey should be done twice—once before the start and once after the campaign—so that the two may be compared.

Using the data collected during the survey, students could calculate the units and cost, of a fan and light which are not switched off for an hour, and for a day.

Electricity Survey for the School

A. Complete the Table

Appliance	Class				School			
	Number	*Working hrs/ month**	*Number (you think actually required)*	*Should work hrs/ month**	*Number*	*Working hrs/ month**	*Number (you think actually required)*	*Should work hrs/ month**
1. Incandescent bulb								
a. 40W								
b. 60W								
c. 100W								
d.								
2. Fluorescent tube light								
a. 20W								
b. 40W								
c.								
3. Fans								
4. Slide projector								
5. TV								
6. Video								
7. Public address system								
8.								
9.								
10.								

B. Answer the following questions

1. How many times in a week did you find lights and fans 'on' in your class when nobody was present in the room?
2. Does your school campus use energy efficient lamps (CFL) Yes/No:
3. The total electricity bill for the past year of the school was _____
4. The total electricity bill for the past month of the school was _____

* Approximate

Neighbourhood Survey

Home and neighbourhood survey should be done during holidays.

Students should conduct the survey at five or six houses at a time, using the home survey sheet.

Electricity Survey for the Home

A. Complete the table

Appliance	*No. available*	*Approx. working hrs/month*	*No. that may suffice*
1. Incandescent bulb a. 40W b. 60W c. 100W			
2. Fluorescent Tube light a. 20W b. 40W			
3. Mosquito repellent			
4. Fans			
5. Refrigerators a. 165 lts b. Others			
6. Mixer/blender/juicer			
7. Hot plate			
8. Iron			
9. Instant Geysers			
10. Immersion Water Heater			
11. Television			
12. Radio			
13. Video			
14. Stereo System			
15. Others			

B. Answer the following questions

1. How many times in a week have you found the lights, fans and other electrical appliances on when nobody was present in the room? Do you switch it off?
2. Do you have energy efficient lamps (CFL) at your home? Yes/No:
3. i. The total units of electricity consumed during the last month at my home was _____

   ii. The electricity bill for the past month in my home was _____

Taking action

After the survey, students should take up an action campaign, both as individuals and as a class

Some tips for taking action are listed below:

- If the electrical appliances are not switched off after use, they should put a note asking the person(s) using it to switch it off after use and also to switch off other lights and fans when leaving the room.

- Form groups to patrol the campus at intervals (during recess, lunch, etc.) to determine if there are any appliances left on in unoccupied rooms, and then bring it to the notice of the person concerned. Or, if they have the permission, students may enter the room and switch these off. (Prior permission is always required, as in the case of laboratories, where experiments may be going on, even during the recess.)
- Talk to the school administration to get them to maintain the electrical appliances in proper condition (not letting dust accumulate on the lights, keeping them clean, following the instructions for using the electrical appliances properly, etc.)
- Keep a record of the electricity bills every month to determine whether the bill has reduced after the awareness campaign. This is a great achievement for the school and this news could be displayed on the notice board and announced in the assembly.

The student could also display eye-catching posters on tips for conserving electricity.

Students could evaluate the outcomes of their efforts through another survey with a form similar to the one used earlier.

Kids Did It!

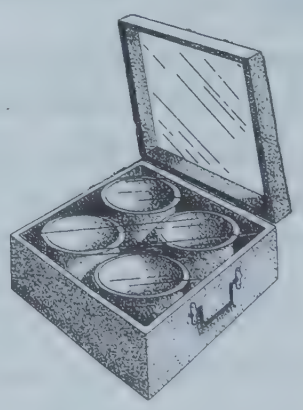
Students of an Eco-Club in Ahmedabad associated with CEE took up a project to encourage consumer efforts in electricity conservation. After having been oriented about the issue and how to tackle it, students initiated interaction with the residents of a large apartment complex. They provided residents with information about the electricity consumption of different appliances, along with a questionnaire to assess the number, types and duration of use of appliances in each home. The data thus collected was compiled and analyzed, based on which suggestions were made for more efficient use. The results were presented to the President, Secretary and residents of the complex. Tips for efficient electricity use and consumer guides prepared by the Ahmedabad Electricity Company, were distributed. Residents were requested to fill out these guides with details of consumption and meter readings.

Students collected the guides after four months and compared the bills from before and after the initiation of the project.

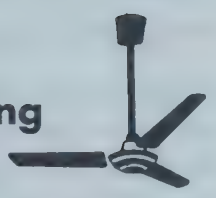
Source: Gopal Kumar Jain, CEE

Tips for the Energy Brigade

- Select a light paint colour for walls and ceilings as it will reflect more light.
- Even if you are using a washing machine, dry your clothes in sunlight rather than using dryers.
- If possible, use a solar heater for heating water and a solar cooker for cooking.
- Maximize the use of natural light—early to bed and early to rise would cut down on your electricity bills. Position reading tables near windows.
- Help fans do their work. During summer, keep the lower level windows closed and the upper level ventilators open. This allows the lighter hot air to escape.
- Night air is cool, so keep the windows open at night. First thing in the morning, close the windows to keep the cool air in and the hot air out.
- Install a solar water heater. In most parts of the country, it could be used for at least eight out of twelve months, and you could save up to Rs.1000/- per year in electricity bills.



Calculating the Cost



A 1000 Watts electrical appliance consumes one unit of power every hour.

Per unit cost of electricity in Ahmedabad is Rs.2.30. Therefore, if a fan of 60 watts runs for 24 hours in Ahmedabad, how much would it cost to run?

One unit is consumed in 16 hrs and 40 min i.e. 1000 minutes

Therefore in 24 hrs or 1440 min how much electricity is consumed?

$$\frac{1 \text{ unit} \times 1440 \text{ min}}{1000 \text{ min}} = 1.44 \text{ units would be consumed.}$$

If one unit costs is Rs.2.30 then 1.44 units costs Rs. 3.31.

Energy Consumption of Some Home Appliances

Appliance	*Energy used in watts*	*Time in which one unit of electricity is consumed*
1. Night lamp (zero watt bulb)	15	66 hrs 40 min
2. Incandescent bulb		
25W	25	40 hrs
40W	40	25 hrs
60W	60	16 hrs 40 min
100W	100	10 hrs
3. Fluorescent tube light		
20W	34	39 hrs 25 min
36W	50	20 hrs
40W	54	18 hrs 30 min
4. Night lamp	5	200 hrs
5. Mosquito repellent	5	200 hrs
6. Fan	60	16 hrs 40 min
7. Air cooler	115	8 hrs 40 min
8. Air conditioner 1.5 ton	2300	25 min
9. Refrigerator		
165 litres	105	9.5 hrs
300 litres	125	8 hrs
10. Mixer/blender/juicer	450	2 hrs 15 min
11. Iron (light in weight)	450	2 hrs 15 min
12. Water heater		
1-2 litre capacity	3000	20 min
15-17 litre storage	2000	30 min
13. Washing machine		
without dryer	230	4 hrs 20 min
with dryer	400	2 hrs 20 min
with water heater	900	1 hr. 6 min
14. Water pump	750	1 hr. 20 min
15. Television	80	12 hrs 30 min
16. Radio	15	66 hrs 40 min
17. Stereo system	50	20 hrs
18. Water purifier	25	40 hrs

Source: GEDA (Jan-Dec '94 *Urjapatra* Vol. 7)

Fuel

Understanding the Issue

50 per cent of all energy produced in the India is used for cooking, and 90 per cent of it comes from noncommercial sources like firewood, dung cakes, etc. Apart from these, charcoal, kerosene and LPG are also used for cooking. Commercial fuels like diesel, petrol, etc., are used in vehicles and industries. As these are non-renewable natural resources, they are limited and will not last for long at our present rate of consumption. Conservation of fuel is most important in today's context.

Transport

Students could be introduced to the subject through videos and general discussions on the increasing number of vehicles, increasing population leading to an increased demand for fuel, deteriorating air quality, discussion on current press reports, etc. Students should also understand that over-consumption of fuel not only affects the valuable reserves of fossil fuels, but also affects the environment and health through pollution. Students should be made aware of the fact that even though their contribution may seem small, in the long run it would make a great impact.

A visit to a petrol pump is an interesting and thought-provoking way to help students get a realistic idea about vehicles and fuel consumption. It is important for the visit to be structured so that students get useful information which would help them plan and undertake the project. Small groups of students could each visit different petrol pumps. Some questions that they could ask the pump attendants are given on the next page.

Survey

Students should conduct an initial survey on the use of different kinds of vehicles by the school community. They could begin to collect this information with the help of questions given alongside, first with students in their own class, and then by circulating the questionnaire to all the classes and the school. Students could also count the number of petrol driven two-wheelers in the parking area, to substantiate the data collected through the survey.

The students should discuss their findings in the classroom and then determine to what extent the traffic and pollution problem would be solved if less private vehicles and more public transport, or environment friendly transport like cycles, were used.

Vehicle Use

- How many students and staff come to school by a private vehicle other than cycle?
- How many of the students and staff come to school in a shared/hired vehicle (autorickshaw, van etc.)?
- How many students and staff use public transport (buses, trains)?
- How many students and staff walk or cycle to school?

Questionnaire for Petrol Pump Attendants

1. How long have you been working in the petrol pump?
2. On an average, how many litres of the following do you sell every day:
   Petrol
   Diesel
3. Has there been any change in these amounts from the time you started working and now?
4. On an average how many of the following do you attend in a day:
   Cars
   Two wheelers
   Autorickshaws
   Buses/Trucks
5. Has there been any change in these numbers between the time you started working and now?
6. Do you serve unleaded petrol?
7. If so, do you know the advantages?
8. How many vehicles (on an average) use unleaded petrol?
9. Are you authorized to issue pollution under control (PUC) certificates to the vehicles?
10. If so, how many vehicles have been issued such a certificate?
11. How many vehicles do you think (on an average) are maintained properly—proper tyre pressure, well-oiled, having PUC certificates, etc.?

Taking Action

After the initial survey, the students can compile their findings and arrive at a general picture of vehicle use by the school community. They can then discuss and analyze why children/staff using private/hired vehicles are doing so, and explore ways by which these patterns could be changed so as to reduce use of fuel and also reduce pollution. They could plan a campaign to encourage others to make efforts to reduce the wastage of fuel.

The students could:

- Display posters depicting the congestion and pollution caused by vehicles and emphasize that more vehicles on the roads means an increase in consumption of non-renewable fuel and pollution.
- Collect information from the local Regional Transport Office (R.T.O.) about the number of vehicles in their city, and the annual increase. This can be shared with the rest of the school through notice board, posters, assembly, etc.
- Invite a health expert to discuss the health hazards of pollution caused by vehicular emissions, and individual smoke and fumes.
- Persuade all students to use an environment friendly mode of transport, i.e. cycle or walk, or if the distance to be covered is too great, use public transport as far as possible.

Tips for Transport Trackers

- Walk or cycle when possible
- Take a bus rather than a personal vehicle
- Travel on scooter or car only if there is no other way to go
- Drive at a steady speed
- Depend on the accelerator rather than the brake to control the vehicle
- Get your vehicle serviced regularly
- Correct tyre pressure improves mileage.

- Encourage the students or request the Principal to declare one day in a month, as a day on which everyone uses either a bicycle or public transport.
- Prepare attractive leaflets with tips on fuel efficiency, and arrange for these to be distributed to all vehicle drivers at petrol pumps.
- Share the tips with others at school and at home, through skits and dramas, posters, etc., and encourage them to notice the difference.

Students could observe and record vehicle use by family members (see box below). This survey can be conducted over a period of one week.

They can share their learnings from school with the family and work out ways, as a family, to reduce vehicle use wherever and whenever possible.

Vehicular Use Survey at Home

- How many times in a week do you or members of your family use a personal vehicle to go to the nearby market for shopping?
- How often do you use public transport?
- If you have a car, is it used by only one person, or are there more people who share the car to go to the same place?

Cooking Fuel

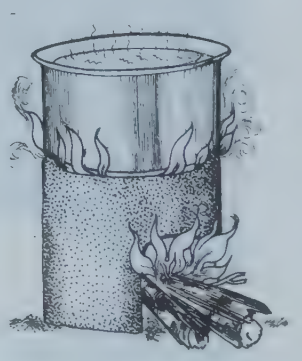
Students could begin with an investigation of their kitchen to find out what is cooked, how it is cooked and the eating habits of the family. They could note the number of meals cooked everyday at home, the number of dishes in each meal, and the time it takes to cook each meal, how many times food is re-heated before being eaten by family members, etc. Students could then find out about the cooking fuel used in their homes, and how much money the family spends on it.

They should find out and discuss the environmental impacts of the fuel they use.

Once they have collected information about cooking habits as well as fuel consumption in their home, students should try to understand where wasteful consumption may be taking place, and in what ways this could be reduced. They should discuss with the family and collectively devise measures to reduce fuel consumption, using the tips (on next page) as guidelines. The home action plans and their outcomes should also be shared and discussed in the class.

Fuel Facts

- A bus uses one litre of diesel to go four km, and can carry 52 people at a time.
- An average car in the city goes only about 15 km on one litre of petrol, and can carry five people.
- A scooter transports two people a distance of 50 km/ litre of petrol.
- A bicycle can do the same for free!



Tips for the Kitchen Rangers

- Keep vessels covered while cooking.
- When the liquid in the food starts to boil, turn down the flame.
- Use a pressure cooker.
- Use the smaller burner of the gas stove whenever possible.
- Soaking rice, pulses, etc., before cooking can save up to five per cent fuel.
- Do not put items in the refrigerator when they are still hot.
- Keep the coils at the back of the refrigerator clean.
- Use a solar cooker. Exploit the abundance of sunshine.
- Get your family to eat together—it will save re-heating fuel.

Cooking Fuel Survey Sheet

- What is the fuel used for cooking (fuel wood/kerosene/ LPG)?
- How much fuel is used per day/per month in your home?

  (Fuel wood could be measured in kgs/day, kerosene in litres/day and LPG by dividing the weight of the gas in the cylinder by the number of days it has lasted. For the latter, ask your mother for assistance.
- What is the cost of one kg of fuel wood, one litre of kerosene, one gas cylinder?
- How much does your family spend for cooking fuel?

Outcomes

All these conservation actions could be taken both at home and in the school. If the activities are to be done at home, the holiday period is ideal. The teacher should give a rough outline of the process before the commencement of the vacation. The students could then prepare a report and have a discussion about the changes they have brought about in their homes, such as taking initiative to close taps which are left open, cleaning the lights, switching off tube lights and fans while leaving the rooms, etc. They could also include how their activities have helped to reduce water, electricity and fuel bills compared to the previous month(s). The changes brought about by them would help them in becoming responsible citizens and in making conservation a way of life.

Energy Report Card

Energy Habit	Always Do	Sometimes Do	Never Do
● Turn off the light when I leave the room			
● Turn off the fan when I leave the room			
● Walk to school			
● Close refrigerator door quickly			
● Cover vessel with a lid while cooking			
● Use mains rather than battereies			

ANIMALS IN OUR LIVES

- Dogs, considered to be the most faithful of animals, were domesticated more than 10,000 years ago by humans.
- Dragonflies act as biological pest controls, as they feed on mosquitoes and gnats. Hawks, owls and other birds of prey may be used to control the proliferation of mice and other rodents.
- Vultures, kites and crows are important scavengers. By feeding on carcasses, they prevent them from becoming breeding grounds for various disease-causing organisms.
- Birds act as pollinating agents. The flowers of several trees are fertilized by different species of birds.
- Rat snakes help farmers by eating frogs and rodents in the field.
- The mosquito fish, or the Gambusia eat mosquito larvae and help to control the spread of malaria. Guppies and Tilapia are also used in controlling mosquito breeding.
- Ladybird beetles feed on aphids and scale insects which are pests in orchards.
- Earthworms bring 1.2 to 1.5 tons of soil to the surface per hectare, improving soil texture and the drainage of water.
- Many medicines originated from animals. The first anticoagulant was produced from leeches that secrete an enzyme, hirudin, with anticoagulant properties.

Photo Courtesy : CEE

In the present day context where children's interactions with animals have been reduced, and often completely denied, there is a need to create opportunities for students to learn about different animals, their habitat requirements, their behaviour patterns, their role in the environment and interaction with other life forms, etc., and to encourage them to care for all living things.

Caring Traditions

Traditionally, there were practices which encouraged sensitivity towards, and care of, animals. Animals like cows are respected and worshipped. Women of the house would feed crows before serving food. In South India, people make "*kolam*" or "*rangoli*", from rice flour, in front of their houses, which is an indirect way of feeding ants. In any part of India many people feed grains to the birds, as a custom and also because they like doing so.

Why Care for Animals?

- Animals play an important role in keeping nature's balance. Every small or big animal, including humans, is dependent on others in some way or the other.
- The rapid destruction of forests, and the growth of human habitations and activities have reduced the natural habitats of animals. Loss of habitat is one of the major pressures on several species and has led to the extinction of some. We therefore have a responsibility to preserve remaining habitats and thereby their inhabitants.
- Children have a natural affection towards animals. Those in urban areas have few possibilities of interacting with animals and birds. This results in fears or prejudices, or insensitivity towards animals. There is a need to inculcate in children a healthy attitude towards animals, so that they will grow up to be caring and sensitive.

To help achieve these, some projects based on animal care could be taken up.

What Can Be Done?

A variety of projects that involve students in getting closer to, caring for, observing and studying local "wildlife" (i.e., small animals, birds and insects in the area) could be taken up.

Some possibilities are given below:

1. Construction of nesting boxes for birds: Creation of artificial nesting sites would give an opportunity to the students to provide birds with a place to nest and breed.
2. Feeding trays and water sources could also be made for birds and animals. These would attract animals and birds, and provide students the opportunity to observe some of their behavioural patterns.
3. Planting of wild flower or herb gardens also attracts butterflies, bees and other insects. This would give the students a chance to provide a habitat for birds and animals, and also observe and study these creatures.
4. Studying the life cycles of some commonly found insects such as butterflies, moths, weevils, etc.: Students can find out at which stage in the life cycle, the insect is considered beneficial or destructive by humans. During this study they would also find out which stage in the life cycle insects are fed upon by predators. In the case of pests, they could also study whether they could be controlled by biological pest control or by using any of the traditional preventive measures.

5. Promotion of biological pest control could be achieved by creating habitats for birds that feed on pests and finding out about natural pest control.

Choosing a Project

Animal care projects could be of two broad types: Study Projects and Action Projects. Usually, a Study Project leads to an Action Project.

Study Projects

Students could take up projects which involve some library research, surveys, observation, experimentation, monitoring and recording. The information collected by this process could be compiled into a booklet, brochure, or a data base, to be used by other students or persons as reference in the future. This information may form the basis of an action project. Some interesting study possibilities are listed below:

Surveys

a) recording of local wildlife activities
b) bird counts

Observation of Life cycles

a) of moths and butterflies
b) of grain/flour weevils
c) of frogs and toads

Investigating Pest Control and Fertilizers

a) household pest control
b) agricultural pest control
c) bio-fertilizers

Learning About Preventing Cruelty to Animals

a) condition of animals in hatcheries, abattoirs, etc.
b) testing of products on animals
c) dissection

Action Projects

These projects involve students taking action to improve the habitat, so as to attract birds, animals, insects, and following this up with observation and recording. Some of these include:

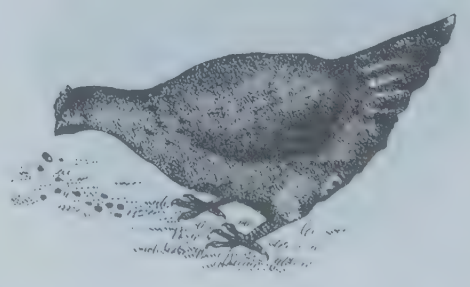
Creating Habitats

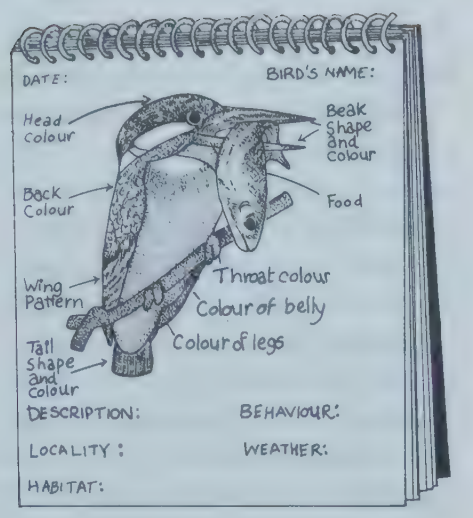
a) for small animals that are usually found under the stones, bushes, etc.
b) nest boxes for the local birds
c) small artificial ponds for aquatic animals

Making feeding platforms

Chain Reaction

The use of chemical pesticides has been known to affect animals in addition to the pests they were supposed to control. For example, the use of DDT as a pesticide has affected the birds that feed on the pests, leading to the thinning of egg shells, thereby increasing the incidence of egg breaking and improper development of the embryo. This has affected the local bird population drastically and consequently, led to an increase in the pest population. Biological pest control in contrast does not have any such side effects.





Surveys

Whether the students decide to take up a study project or an action project, an important step would be to survey the area in which the project is to be implemented. Such a survey is itself a valuable learning opportunity, and can develop skills of observation and recording of the environment. The findings of the preliminary survey would help in developing the kind of project students take up, e.g. the insects or birds that need to be studied or exact nature of the habitat, or nesting/feeding site to be prepared. For example, selecting the type of nest that is to be used most in the area, or the type of grains or other food to be scattered to attract the birds of the area, etc. This is important, as the project may not be very rewarding for the students if the nest boxes they prepare are not used, or the feed they have put out is not eaten.

Thus a survey becomes a preliminary activity in either project.

One step towards studying the area would be to undertake a nature trail around the area in which they intend to work, such as the school grounds, near their home, garden, in the neighbourhood park, or any other suitable place. Students should note the different kinds of plant and animal life found along the route. They should also note, after patient observation, whether some kinds of insects, birds and other animals seem to frequent particular kinds of plants, e.g. butterflies are often seen near milkweed plants.

They could use the following format to note their observations.

No.	*Month/ Season*	*Time of the day*	*What was observed*		*What were the animals feeding on?*	*Any problems that animals seem to be facing?*
			Plants	*Animals*		

After observations made during their "nature trail," students may decide on any particular aspect of animal observation or care to work on. If they take up a study project, they may do the trail at regular intervals. If they plan an action project, the trail could serve as a good starting point to decide what exactly to take up, where to do it and what it may involve.

Study Projects

A Calendar of Local 'Wildlife' Activities

Students could create a calendar of activities of the animals, birds and insects found in their neighbourhood. They could use the observations from the trail and the information collected, to make individual activity calendars for as many of these as possible. Each student or group of students could decide to find out about one of these animals, and each should maintain an individual notebook or observation note pad, which they carry along with them and fill up on the spot. They could also maintain a common chart on a notice board in the class or school on which to enter what they have observed, giving the date and time, location of sighting, and activity. At the end of a year's observation and recording, students could make detailed booklets for each animal from the information collected, to be used as a reference tool, for themselves and others, in future. See the sample given below.

Name of the animal:
Local name:
Scientific name:
Period of observation: From —— to ——

Period	*Activity*
June 1st week	The bird was bringing in twigs, feathers, etc. and was building the nest. Courtship dances could be seen.
2nd week	The bird was found sitting in the nest. It had laid eggs early in the week.
3rd week	
4th week	
July 1st week	

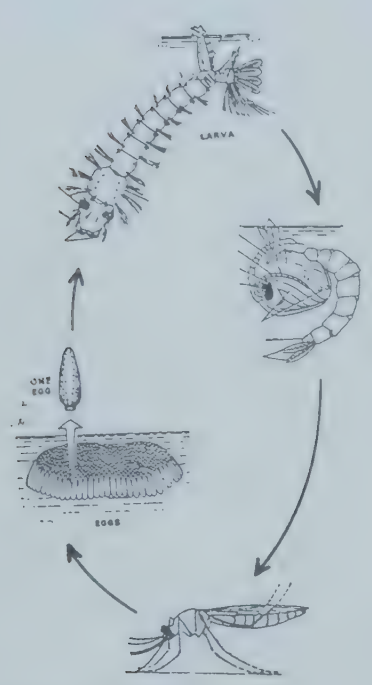
Students should try to obtain as much information as possible about the animals' habits without disturbing the animals in their natural environment. For example, they should not touch a nest while the bird is building it, or when eggs or chicks are in it.

Discussion and Follow-up

Once the students have begun collecting information about the animals commonly found in the neighbourhood, they should regularly discuss their findings in the classroom They could

Mother and Child

It would be interesting to discuss how different animals have different life cycles, for e.g. cats, dogs, etc., give birth to young ones which look like the adult; hens and other birds lay eggs, which they incubate until chicks hatch, which may look quite different, from the adult bird. There are insects, like butterflies, whose young ones do not resemble them at all!



Life Cycle of Mosquito

Life is a Stage

Most insects hatch from eggs and go through several stages of life. The process of change is called metamorphosis. Some insects go through an incomplete metamorphosis consisting of three stages: egg to nymph to adult, including silverfish, cockroaches, grasshoppers, dragonflies and lice. Other insects, such as butterflies, moths, ants, bees, wasps and beetles, go through complete metamorphosis: that is, they go through four life stages: egg to larva to pupa to adult. In this case the adults have a very different appearance and even eat different foods. A caterpillar is the larval stage of a butterfly.

conduct library research to find more information about the animals they are observing during their survey.

The students' observations could also lead to the initiation of an action project. If the students have found (through their observations, discussions, and library research), that their project area is lacking the suitable plants which would attract butterflies and moths, then they may try to plant such plants in the neighbourhood.

Life cycles

To learn more about insects in the context of their habitats, the students should know about the various stages in the life cycle of the insect, what they feed on at each stage, what time of the year they are found, etc. Apart from observing in nature and through library research, students could find out more by doing a simple activity in their classrooms or homes.

Students could observe the life cycles of some commonly found animals like butterflies, moths, frogs, weevils found in grain and flour in households, etc. They could also observe how in nature these become food for others higher up in the food chain, or eat some other animal that is considered as a pest. This would introduce them to the concept of biological pest control as nature's way of keeping the balance. This study would also help the students in identifying which stage in the animals' life is most destructive, and in which stage of the animals' life cycle it is fed upon by other animals. This, along with knowledge about seasonal changes in the population, would help in charting out an integrated pest control strategy that may be most suitable for the area.

The students should observe an area, the school campus or the neighbourhood, and make a list of the insects that they find, enlisting the help of a knowledgeable person to identify the insects. If such a person is not available, then they could draw the insect as accurately as possible and along with a note on its colouring and feeding habits, send it to the nearby college or university for identification. If this part of the exercise has already been done during their survey ("nature trail") then this step may be omitted. Students may then look for the young ones, e.g. caterpillars, to collect specimens and begin their "life cycle" study.

Moths and Butterflies

Requirements: Wide mouthed transparent bottles, a piece of thin cloth to cover the bottle mouth, thread or rubber bands, appropriate food for the insects (leaves of the plant on which the caterpillars were found), absorbent paper

As different kinds of caterpillars have different feeding habits, before collecting the caterpillars, the students should note these

feeding habits, e.g. what leaves or fruits they are feeding on. The caterpillars should be fed on the same kind of food once inside the box/bottle.

Caterpillars may be collected from vegetables brought from the market, inside pea pods or brinjal, etc., or from the garden. If an outdoor collection of caterpillars is planned, then the teacher should oversee this, taking care that students do not crush them during collection, or indiscriminately collect all available caterpillars, as it would affect the ecological balance.

Students should use a stiff paper to collect the caterpillars, as using fingers to pick them up may injure them The paper may be placed under or by the side of the caterpillar, and with another piece of paper or brush, they should gently push it on to that paper without harming the caterpillars. Some of the insects and their young ones (caterpillars) may be poisonous. Take care that the students are aware of this.

Before putting the caterpillar into the container, the students should place absorbent paper at the bottom of the container and collect a few leaves of the caterpillars' food plants. Then cover the mouth of the container with a thin cotton cloth. They must make sure no other insect or spider is inadvertently put into the container with the leaves, as this may kill the caterpillars.

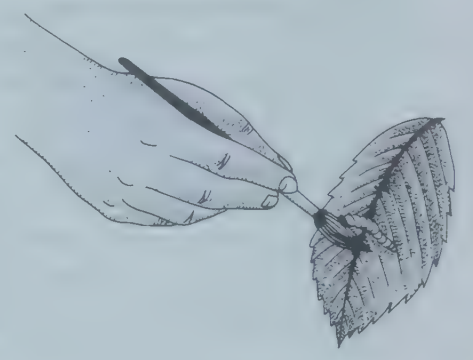
The number of caterpillars in a container depends on the size of the container and the caterpillars. There should be enough space for the caterpillars to move about in the container and also enough food. If the caterpillars are big, either they should reduce the number of caterpillars, or use a bigger container.

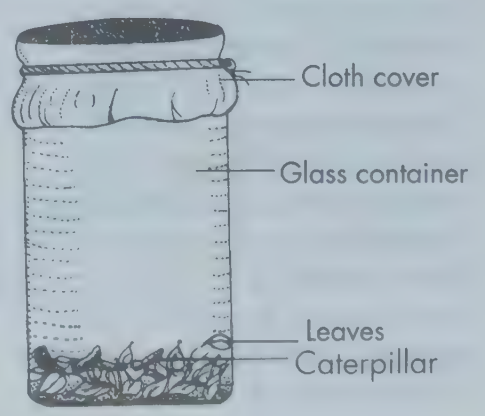
It is important to put in fresh, clean leaves everyday, as growing caterpillars need a lot of food. Students should make detailed notes on their daily observations. When the caterpillar is fully grown, they will notice that it is restless, until it settles on a twig or the side of the jar where it attaches itself by spinning a pod of silk. The next day it sheds its caterpillar skin and begins to look like a pupa.

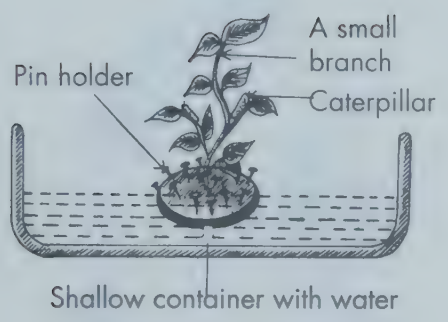
Students should note the date on which this happens. They may have to wait patiently for 12-15 days, in warm weather, for the next stage. They must continue to observe the pupa. Emphasize that the pupa must not be disturbed in any way, as this may harm the growing insect inside. One day the wing colours of the butterfly in the pupa case will be discernible. They must be alert because the butterfly is likely to come out the next day. When it first comes out, its wings will be wet and crumpled. Make sure that the container has enough space for the wings to fully stretch. Let the students closely observe the butterfly before they open the container and gently free the butterfly, allowing it to flap its wings and fly away.

Find a Caterpillar

Curry leaf or lemon plants are an ideal place to find caterpillars of common Mormon or Lime Butterflies. The caterpillars resemble fresh bird droppings and lie in the middle of the leaf. The rainy season is the best time to look for caterpillars of moths. You may discover caterpillars in the pea pods you get from market, a rose bush, or the buds of gladioli or tuberose plants.







Caterpillars of some moths prefer to pupate in soil. In case you are not sure of the kind of caterpillars the students have collected, the students may put 5-7.5 cm of garden soil at the bottom of the container and cover it with dried leaves. They must also place some twigs in the container. It will be interesting to observe whether their caterpillars prefer to pupate on the twigs, or the side of the container, or the soil.

Kids Did It!

Students in a school in Mumbai, Maharashtra, attempted an interesting variation on the "leaves in a container" method of rearing caterpillars. Having discovered four to five caterpillars on a branch of a lime tree, they cut the small branch and placed it upright (with the help of a pin holder) in a shallow container with water in it. The caterpillars on the branch moved about freely on the branch, eating the leaves of the branch. When only a few leaves were left, the branch was replaced with a fresh one from the same tree. The students could thus easily observe the caterpillars at all stages. They could even take them onto metal rulers, measure them and put them back. The caterpillars could not escape because of the water in the container.

Source: Shobana M. Bijoor, Parle Tilak Vidyalaya, Mumabi

Household Pests

Grain or Flour Weevils

As a variation, students could also observe the life cycles of household pests such as insects found in grain. Some animals which consume or destroy food materials or any other substance which is considered useful and of importance, are considered to be pests.

Students could check in the kitchen and collect the grubs/larvae and weevils in rice, flour and pulses and put them in a transparent bottle or container.

They should note from which sort of food— i.e. grain/flour they picked up the grubs/weevils, so that they put similar food in the container.

The mouth of the container should be covered with cloth. Each container can have 8-10 weevils/grubs to begin with.

The students should observe and note the following:

- when were the insects/larvae collected (the date)?
- when were the changes observed (after how many days?)
- what were the changes observed?
- how long did it take the insect to complete one life cycle?

Kitchen Pests

Two common pests of stored grain are the Red Flour Beetle and the Bruchid Beetle. Red Flour Beetles are long and flat in shape and reddish brown in colour. They are found in wheat. The female lays about 350 eggs which hatch within 5-12 days. The larvae pupate after four weeks. Adults emerge within three to seven days. Bruchid Beetles are brown and stout. Their larvae burrow into the seeds, where they feed and pupate. Adults emerge through a hole in the seed.

Household Pest Survey

Students could conduct a survey in their homes and neighbourhood to observe and find out about common pests (inside the house as well as outside in the garden, etc.) and how they are controlled. They could also speak to older people (grandparents) and find out how these pests were controlled in their time.

Students could ask the following questions in their survey:

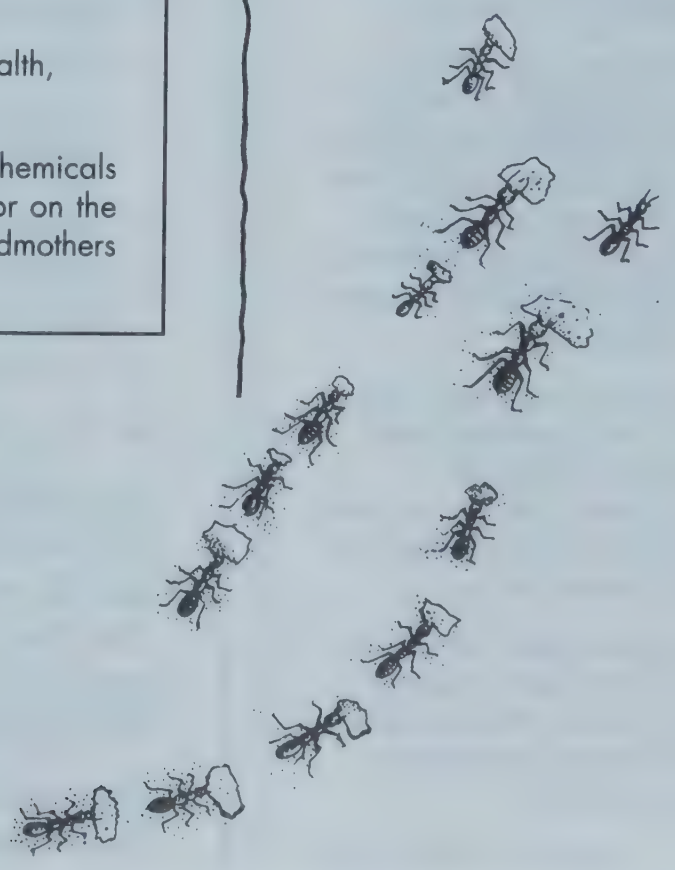
1. What are the common household pests:
   a) those found in food grains
   b) others found in the house (in books, woolens, cracks and crevices, etc.)
   c) those found on the plants in the garden
2. How is each one controlled:
   a) chemical pesticide or other form
3. If chemical pesticide is used,
   a) what is the pesticide used?
   b) what is the chemical in the pesticide (e.g. aldrin, malathion, parathion)?
      (The students could find this out from the container/cover of the pesticide).
   c) what precautions are to be taken while using the pesticide?
   d) how much does it cost?
4. How were these pests controlled earlier, without pesticides?
5. Did that method harm any other organism apart from the pest?
6. Was it effective?
7. What was the reason for the change from traditional to chemical pest control?
8. Do these chemicals seem to have any effects on human health, other organisms or any part of the environment?

Students could find out from books or other sources whether the chemicals used are known to have harmful effects on other organisms or on the environment. Students could also find out from their mothers or grandmothers about various measures to prevent stored grain pests.

Grandmother's Recipes

Traditionally, household pests were controlled by a combination of techniques. Nowadays, few have the time or the know-how to practice traditional methods. Use of packaged chemicals is becoming more frequent, which affects not only the pest concerned, but also other organisms, including human beings. Here are some "Grandmother's Recipes" which are not only effective but also safe and environment friendly!

Neem leaves and dried lemon peels have been traditionally used as pest repellents. Dried neem leaves and dried pepper stalks (after extracting pepper) are mixed with rice and other grains to repel storage pests. Cow dung mixed with water is also used to wash areas to repel pests. A line of turmeric powder is said to keep ants away. To avoid pest infestation in stored food grains, the grains are coated with castor oil. Burning different kinds of plant leaves, e.g. Parthenium, as "dhup" was another way of keeping flies and mosquitoes away.



Natural Pesticides

Natural pesticides (organic pesticides) derived from plants could also be used for control of agricultural pests. Some examples are given below:

- An extract from the seeds of the neem tree sprayed on plants has been found to provide some protection against insect attack.
- Jaggery to control white flies (in cotton): One kg of jaggery is mixed with 10-12 litres of water and the mixture spread over crops using a hand sprayer.
- Rat control: Leaves of *Ipomoea fistulosa* (*videshi aak*) are boiled in water and filtered. Sorghum grains are boiled in this extract and placed near rat burrows as it is believed that consumption is fatal in rats.
- To protect sugarcane crop from soil inhabiting pests, before planting the sugarcane cuttings, dry dung and other crop residues are burnt in the furrows.
- Decoated neem kernels are soaked in water overnight. The next day the decoction is filtered and sprayed on bengal gram.

Source: Honey Bee, 1996

Once the students discover the answers to the above questions from their surveys, they could compare and compile the information collected.

They could then spread the message about the benefits of non-chemical pest control.

- They could make posters with information on alternatives to chemical pesticides. This could be done by finding out from elders as well as from books, magazines for farmers, etc., which discuss different ways of controlling pests in the field.
- They could send their findings to the local newspapers/ magazines to be included in the children's section.
- Stage plays about accidents related to chemical pesticides and how they could be avoided through use of other methods, would also be effective.

Pests in Agriculture

Students could carry out a survey among farmers and field workers of nearby fields to find out the following:

- What is the crop grown there?
- How many times in a year is it harvested?
- Is there any crop rotation practised?
- Has there been any change in cropping pattern or use of fertilizers or pesticides?
- What are the fertilizers used?
- What are the pests in that field and the pesticides used to control them?
- Is there any improvement in the crop production following pesticide use?
- They could find out from farmers, bird watchers and naturalists, whether there has been any change in the bird/ animal population after the start of pesticide use.
- Is there any health effect (skin and eye irritation, stomach problems, etc.) in those handling the pesticide and also those who consume the food material derived from such fields?
- Have they ever used traditional methods of pest control?
- If so, what are they?

The students can find out about recent advances as well as traditionally used methods to control pests. They can refer to specific magazines which provide information on such topics. Then they could spread the information to the local farmers or use the findings to decide on pest control measures for their own gardens.

The students should make a chart or poster of their findings and share their knowledge with others in the school.

Fighting Pests The Natural Way

Chemical pesticides used to control pests have harmful side effects on the environment. Some of them may affect other animals besides the pests. Many seep into the soil, contaminating ground water, lakes, rivers and food sources, and persist for a long time, poisoning the environment for hundreds of years.

Integrated pest management is one way of controlling pests. This involves a variety of pest control techniques, to create a more efficient and safe way to manage insect pests.

There are many ways of controlling pest problems, especially in agriculture, without using chemical pesticides. Some of these are described below:

Natural predators: Introducing the types of animals that will naturally gobble up pests, such as ladybugs, praying mantids, garter snakes, and toads.

Natural parasites: Introducing bacteria, viruses, and insect parasites that will kill pests but will not harm other types of animals.

Mixed plantation: Planting mixed stands of trees or crops instead of large areas with just one type of plant. Mixed stands are less susceptible to insect damage.

Habitat changes: Changing the habitat can physically control many pest species. For example, removing the puddles of stagnant water could help curtail the number of pests that breed in such areas.

Mechanical: Removing eggs, larvae, cocoons, and adults from plants by hand.

Timing: Regulating planting and harvesting to avoid those times when insects are most abundant and damaging, can help reduce use of pesticides.

If chemical pesticides have to be used, it is recommended to optimize their use. For instance, by studying an insect's life cycle, the right amount of pesticide at the right time would ensure efficient use. Less pesticide and careful application mean a more healthful environment and more effective pest control.

Bio-Fertilizers

Students could start composting of organic waste, and if conditions permit, start vermiculture and use the manure in their gardens (either in the school or at home).

Vermiculture

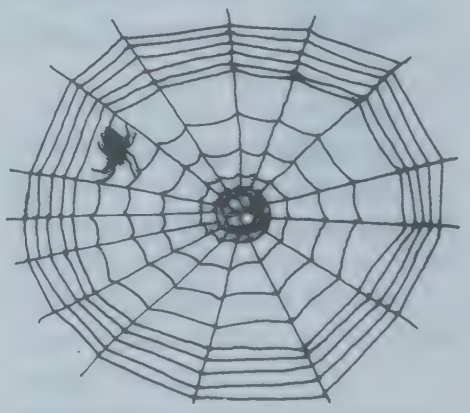
This is a scientific method of breeding and raising earthworms under controlled conditions, through creation of artificially improved conditions for multiplication. In the vermicomposting process, earthworms are fed on a variety of organic wastes to

Spiders: Boon or Bane?

Spiders! The word itself makes some people shiver and quake. And most associate spiders only with cobwebs in dusty corners.

Spiders are part of nature's pest control programme. Spiders are well adapted to many habitats and are voracious predators of insects. They play an important role in controlling pests. They predate upon pests of cotton, apple, banana and rice. The Crab Spiders and Giant Crab Spiders feed on cockroaches and other household insect pests. Wolf Spiders are natural enemies of a dreaded rice pest, the brown plant hopper.

For more details about use of spiders in pest control contact:
Centre for Indian Knowledge Systems
No. 2, 25th East Street
Thiruvanmiyur
Chennai- 600 041



Vermiculture

Some contact addresses:

1. Shri. R.D. Rawal
   Sanjay Baug
   Dhauania
   Tal-Sayla
   Surendranagar -363 440
   Ph. 02755-33325
   (Practises vermicomposting on his farm.)
2. BAIF Development Research Foundation
   Kamdhenu
   Senapati Bapat Road
   Pune 411 016
   (Practise vermicomposting on their farm and provides preliminary training to farmers.)
3. INORA
   c/o Pescoil Co ltd.
   43/1 Karve Road
   Pune
   (Organization promoting vermicomposting professionally.)
4. Ravindra Bhole
   Biogenic Systems
   9 Deepa, Malaviya Rd.
   Vile Parle
   Mumbai- 400 057
   (Consultant, sells worms and castings)
5. Dr. Sultan Ismail
   IRSB
   The New College
   Chennai
   Ph: 044-8267269

produce vermicompost. In this process, earthworms ingest large quantities of partially decomposed organic waste which is then ejected as casts, the vermicompost. The advantages include increase in the aeration of soil, increased soil fertility, and reduction of pollution.

Vermicomposting

Earthworms are often called "Friends of Farmers" because they help the farmers by increasing soil fertility, aeration, etc. Now these wriggly creatures are being used in "vermaries" to produce ecofriendly bio-fertilizers from organic wastes.

Vermicompost is loose, dark brown, slightly moist, granular and crumbles easily, and is of excellent quality as manure when compared to the original waste. This could be used as topsoil in fields and gardens.

Students could take up vermicomposting if the conditions are suitable. However, vermiculture may not be successful everywhere as different species of earthworms require specific moisture conditions and soil temperature for successful growth.

Earthworm cultivation

This may be done in cement tanks, wooden boxes, stone-lined pits, aquarium tanks or plastic tubs of approximately 1 m x 1 m x 0.3 m size, (depending upon the quantity of waste).

- Ask the students to collect different types of organic material (e.g. leftover food, leaves, vegetable peelings, etc.) and place in the tank. The addition of cow dung ensures the presence of micro-organisms and helps rapid decomposition.
- Allow about two weeks for partial decomposition. During this period, the temperature in the container will increase. The students should wait until the temperature decreases to about 30° before introducing the earthworms. During initial decomposition, periodical mixing helps in aerating the wastes and also in maintaining uniform temperature. About two thousand earthworms (mixture of different species) and castings should be introduced to the above. The earthworms feed on the partially decomposed waste and produce worm casts.
- Moisture content of 40-50 per cent should be maintained for good conversion. This can be done by periodical sprinkling of water.
- After 40-48 per cent conversion, small circular or oval castings form lumps on the surface as the deep burrowing species excrete on the top.
- After complete conversion, earthworms settle at the bottom of the tank. Material becomes loose, lumps break easily when pressed with fingers.
- The material should be placed along with the earthworms, on the ground and heaped for separation of earthworms and casts. The heap should be left overnight, during which time the earthworms settle at the bottom. The material on top can thus be removed to be sieved and then used as vermicompost. The casts should be separated and stored after sieving.
- The cocoons and young ones should be separated from the adults for introduction into a fresh tank.

Source: Madhavi Joshi, CEE

The Natural Way

Lavkumar Khacher, an eminent naturalist, decided to tackle the pest problem through nature's own programme. Ten years ago, his garden was infested with termites. Local gardeners advised that mixing Aldrex (a chemical pesticide) with the soil was the only way to keep the pests at bay. Mr. Khacher was not convinced. He studied the situation and discovered not only the root of the problem, but also the solution. In his own words: "The termites do not normally attack living plants. They were attacking my plants perhaps because they had no food to eat. The soil having remained bare for a couple of decades was completely devoid of organic matter. Every blade had been eaten by free ranging goats, sheep and cattle and the residue within the soil had been leached down or eaten up long ago by termites and other creatures. I also realized that the soil, when it had not a vestige of organic content, could not retain moisture. Even though water was liberally provided, it rapidly percolated deep down out of reach of the little plants. I now had my answer. Gandhinagar has a large number of very fine old trees and each February and March they shed huge quantities of leaves which, to my horror, are swept into heaps and burnt. Yes, valuable organic matter being sent up in smoke! I got a couple of lads to help me carry the leaf litter and spread it all around the house. Overnight a miracle took place!

The powdered leaf matter, mixed with the porous soil, remained wet. The plants stopped wilting and started throwing up new shoots even as the summer heat increased. Around the roots, the soil was free of termites. They were busy converting the twigs and leaves into soil nutrients. The second and third monsoon saw my garden grow unbelievably lush. Ten years later, as the mercury rises, my little house is in the shade of trees now grown tall. Each morning I savour the early morning freshness on the terrace, watching green pigeons, barbets, bulbuls and mynas fling into the tall *gular* tree to gorge themselves on the figs. Sunbirds, tailor birds, white-eyes, ioras and other small insectivorous birds industriously catch insects drawn to the figs. That gracious fig tree was barely three centimeters tall when I planted it and along with the other little saplings, was on the verge of dying, as was, at that time, my faith in the ability of biological systems to right themselves in the natural way."

Source: CEE-NFS, CEE

Protecting Animals

Children could work towards protecting animals and preventing cruelty to animals and for bringing about changes in the attitudes of people towards animals.

Students could find out about organizations which offer shelter to stray animals in their city or town and contact them if they find any stray animal in need of help. Organizations in many parts of the country offer shelter to stray animals. *Gaushalas* are found in many places, for example, in Ahmedabad, Gujarat it is the *Panjarapol Gaushala.*

Students could find out about voluntary organizations (or individuals) working for the rights of animals, and about their work. They may, if they are interested, become members. They should bring to the notice of these organizations any incidents of cruelty to animals.

Students could display on the school notice board, the name of the such organizations or individuals working in their area, so the other students and staff members could also contact them in case they find an animal which needs help.

They could raise public opinion against those involved in activities which harm animals. They could also conduct an opinion poll about the use of animals for entertainment and could publish their findings in the newspapers or in the school.

Snakes and Sundarvan

In Ahmedabad, Sundarvan, a Nature Discovery Centre, is best known for its display of snakes. The popular Snake Show includes a talk and demonstration of some common snakes, and seeks to dispel some common myths about snakes. The show also encourages people to observe closely, and even touch, some non-venomous snakes, while volunteers talk about them. Another unique feature of the Centre is that people who find a snake in their home or garden may call Sundarvan, which arranges for the snake to be caught and brought back to the Centre. Every year, hundreds of such calls prevent numerous snakes from being needlessly killed.

Animal Welfare Organizations

Society for Prevention of Cruelty to Animals (SPCA) is an organization that takes care of stray or injured animals, fights for the rights of animals and against cruelty in any form. SPCA has offices in many cities in India.

Another such organization is:
Beauty Without Cruelty
4, Prince of Wales Drive
Wanowri P.O. Box-1518
Pune- 411 040

Many animals create a feeling of fear and repulsion, and are surrounded in myth—for example snakes. Students could start a project to find out more about snakes, learn to identify and differentiate between venomous snakes and non-venomous snakes and understand the important role that snakes play as rodent controllers. Children could take up the task of collecting and spreading the information to the rest of the school and to the community, using songs, skits, posters, etc., to communicate the messages.

Students could find organizations in their area/neighbourhood which help specific animals and display such information on the school notice board so that others would also be informed. If they find any stray animal that needs help, they would be able to approach the proper organization.

Action Projects

Study Projects help to generate locale-specific information, which would be very useful for students who want to take up related action projects—either the same group of students who have collected the information, or even another group of students. This would save time on the first stage of an action project, i.e. survey.

Some ideas for action projects are suggested below.

Creating Habitats

Plantation to create a natural habitat or protecting naturally vegetated areas are ways to attract birds, insects and small mammals to either make their home there, or visit. This provides a wonderful opportunity for observation of flora and fauna.

Such projects must proceed systematically. The important steps are described below.

Survey

This is to decide for which kind of animal(s) the habitat is to be created. A survey of the plants and animals in the area would be useful in drawing up a list of animals that are already present in the area. A survey should also be conducted in the proposed area to determine suitability of different sites.

Deciding on What is to be Done

The findings of the survey and a realistic appraisal of the availability of space and resources as well as time availability, would determine the kind of habitat that students could create e.g., a nest or small box for small animals, or a small pond for aquatic animals.

Choosing the Site

The site chosen should preferably be quiet and undisturbed by noise from vehicular traffic or nearby industries; sheltered so as to protect the habitat from rain, high winds etc.; harbouring a variety of vegetation, so as to attract different varieties of animal species; clean, away from garbage mounds. The surrounding atmosphere should also be friendly and it should not attract the attention of miscreants, who may disturb it. In case it is likely that some group may create problems, these persons may also be involved in the project—by seeking their help, giving them some responsibilities, etc.

Planning the Habitat

It is desirable to know about the basic characteristics and habits of some of the commonly found animal species during different periods of the year, so as to facilitate the creation of habitats for them at a time when they need them. Students could enlist the help of a local bird watcher or animal lover, or collect some information on these aspects by general observation.

If there are some trees or patch of vegetation already on the site, students could start observation activities. Plants attract not only birds, but a wonderful variety of insects as well. Finding out about food preferences of different insects would help in deciding what to plant, or alternately which insects to look for, if there are already different plants growing.

Night Flight

An exciting experience for students would be to discover the great variety of "night fliers" that visit the garden. One way to do this would be to hang a sheet of white cloth at an accessible spot in the garden and fix a light bulb or tube light over the sheet. The light will attract not only moths but other nocturnal insects, too. Many will settle on the sheet, giving students a chance to observe them. Another trick that would attract these creatures would be to put some overripe bananas or guava outside, near a glass window. Students may be able to see not only insects, but even bats!

Leafy Hosts to Winged Visitors

Vegetation is an important aspect to be considered when planning habitats. Planting a variety of trees, shrubs and flowering plants will be the start of a rich habitat, which would attract numerous birds and insects.

Vegetation is a direct source of food and it supports the insects and other invertebrates that serve as food for birds and animals. Vegetation also provides sites for nesting, dens, and protection from enemies. Certain trees, especially flowering and fruit trees, are known to attract particular types of birds or insects.

Honey feeding birds like Sunbirds, Flowerpeckers, Starlings, Rosy Pastors and Bulbuls visit trees such as Red Silk Cotton, Drumstick, Indian Coral, and Gulmohar.

Fruit eating birds like Mynas, Barbets, Bulbuls, visit plants like *Ber*, all varieties of *Ficus*, Mango, etc. Sunbirds also visit these plants to feed on the nectar in their flowers. Parakeets and Orioles visit *Neem* and Asoka tree.

Plants attract not only birds, but a wonderful variety of insects as well. Finding out about food preferences of different insects would help in deciding what to plant, or alternatively which insects to look out for, if there are already different plants growing.

Lime tree and amaltas attract butterflies, while fig, *ber* and almond, while saplings of *Jamun* and guava are food plants for a variety of moths. Flowering plants like lantana, marigold, cosmos, periwinkle, verbena, poinsettia, cockscomb, *chameli*, oleander, *madhumatti*, peacock flower, etc. attract not only butterflies and moths, but also wasps, bees, ants, beetles and flies. Some of these use the plants as a food source (nectar, leaves, etc.), while others find a place to lay their eggs.

Source: Lima Rosalind, CEE

Making Homes

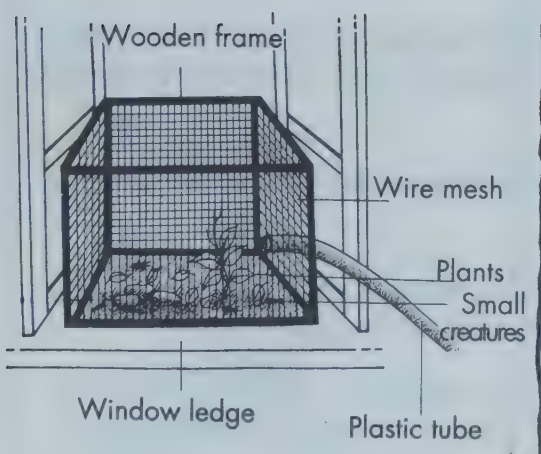
Making nesting boxes, feeding trays or an artificial pond, provides students a chance to apply their theoretical understanding of animals and their habits to a real-life situation. Matching requirements with what is practically possible is a challenging task. Such a project also helps to develop skills, not only of handling materials but also placing these in the appropriate context. The students' involvement at every stage of the process, from research to nest making, is an important part of the education. Such habitats also provide students an opportunity to closely observe the "tenants" or "visitors" and teach them to maintain records.

Homes for Small Animals

Constructing an observation box that becomes a mini habitat for small animals such as millipedes, ants, etc., would provide the students a chance to see these animals at close quarters, without harming either the animals or themselves.

This project could be done at home or in school, provided there is a patch of vegetation or undergrowth nearby. The mini habitats could be placed on the window ledge in the classroom or at home, or even outside in the grounds.

Making the Observation Box



Requirements: Wooden board (one to two m long), wooden strips, a long piece of plastic tubing, (five to six cm in diameter), fine wire mesh

- Using wooden board and strips, ask the students to make a box frame (see illustration). The wooden board is to be used as the base and the strips are to be used at the four corners of the board.
- Cover the sides with the fine wire mesh. One end of the plastic tube is inserted into this box (nearer to the base) and the other end into the vegetation or undergrowth, through which the animals are able to crawl into the box.
- The observation box should be placed preferably at a window or in an open place, where there is enough sunlight and air, and the tube should be long enough to reach the undergrowth.
- Inside the box, a mini habitat is made using cut grasses, bark, stones, etc. Some grasses could also be grown, or plants in a small mud pot can be kept in one corner. At one corner, a small container with water should also be placed.
- Initially a bait (food grains, fruit peels, etc.) could be laid at the ground level end of the plastic tube or inside the tube.

- Observations should be noted, regarding what kinds of animals visit the box.
- The mini habitat does not need a great deal of maintenance. At times, fresh grass may be added and water replenished.

This project would give the students the opportunity to observe and learn more about animals which they usually do not notice. By closely observing their behaviour, the students would learn about the animals' roles in the environment, which would help the students to appreciate nature's diversity. They would discover that often, what we consider as a pest has a definite role in the ecosystem Students would also become more aware of and sensitive to the small creatures which may have been earlier dismissed as being "creepy crawlies" or stomped underfoot.

Nest Boxes

With the reduction in trees and other vegetation, birds are losing their natural nesting sites. This also means that fewer birds are seen in cities and towns. In this project, students would attempt to provide suitable nesting places, thereby attracting birds. This would also help the students to realize the efforts the birds make in nest building and thus sensitize them to the importance of not disturbing them at any time.

Selection of Site and Nest Type

Before initiating this programme, the students should observe the different kinds of birds found in the vicinity of the site, and find out more about each one, e.g. whether the bird is arboreal or terrestrial; how many eggs it usually lays; and in which season; what kind of nest it makes; what sort of materials are used by the birds to build nests, etc.

The nest boxes should take into account the sort of bird or animal that is expected to utilize it. For example, if the box is intended for a sparrow, it should have roughly 25 cm x 25 cm x 25 cm dimensions, whereas if it is for a bigger bird like parakeet, it should be adequately bigger. They should also observe the size variations in the bird species which may use the nest box, as the nest they make should not be too small for the normal size range of the birds.

The students should be aware that the project is not confined to just making a nest box or tray. It would also include keeping the nest clean (not when the bird is using the nest, but before and after this period), keeping the feed in the feeding trays, etc. The other students should be made aware of the project, so that they do not damage or disturb the nest.

Students could experiment with different types of "nests" to try and attract birds to nest.

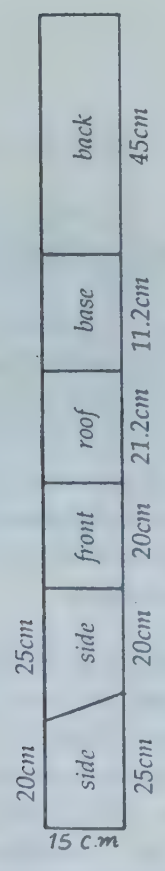
Welcome a Bird!

An earthen pot could be used to attract birds to nest. The size of the mouth of the pot can be adjusted by covering it. Or the mouth may be covered altogether and then a small hole made to allow only small birds like sparrows to come.

The earthen pot could be placed (hung) in one corner of the room near an open window or room. Or it can also be placed in a nearby tree, which can be observed from a window. A box with a small opening can also be used in a similar way.

Baked mud nest

PVC pipe nest



Measurements to make wooden nest

The nest box should be placed as near to the feeding and shelter sites, trees and shrubs, as possible. It should be positioned out of reach of strong sunlight, rain, wind and predators. Before positioning the nest box, the students should obtain permission from the concerned person, generally the owner of the site, building or tree.

Invitation to Nest

Birds that build nests in holes are called cavity nesters. Some of these include Magpie robin, House sparrow, Common myna, Indian robin, Hoopoe, White-throated myna, Bank myna and Parakeets. Such birds are likely to be attracted by some of these:

Baked Mud Nest

A container of baked mud can be used as a nest. This type of nest will be used by all cavity nesters. Their nesting season is from February to mid-August. Such a pot can be bought ready-made or ordered from a potter, depending on the size. This is cheap and can be used in all seasons and for several years. There should be small holes bored in the floor of the nest so that water does not remain in the nest. This nest can be hung on a tree or kept as shown. The length should be 21-25 cm. The entrance to the nest should be approximately 4-6 cm in diameter.

PVC Pipe Nest

This nest is best suited for Brahminy mynas. A PVC pipe, about 14-21 cm in length and 4-6 cm in diameter can be used. One end of the pipe should be sealed. Holes should be made on the surface of the pipe for aeration. This could be fixed to a tree or hung from a branch.

Coconut-shell Nest

Coconut shells can be used to attract House sparrows to make a nest. Holes should be made on the sides of the shell and with the help of a string, it may be hung on to a branch.

Wooden Nest

A box type of nest made from wood may be used by cavity nesters. Nest boxes can be made by nailing together pieces of wood cut from one 15 cm wide board as shown in the figure. To make a nest box out of cardboard, the following will be needed: pieces of wood or strong cardboard, saw, ruler, nails, glue, etc.

To attract birds, initially a few grains can be scattered around the nesting place. Once the bird is attracted and begins to use the nest, the students should observe carefully and make notes.

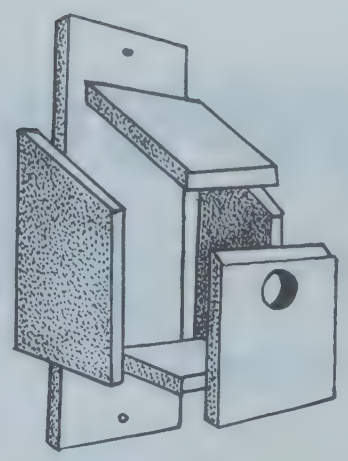
Here are some points that should be noted:

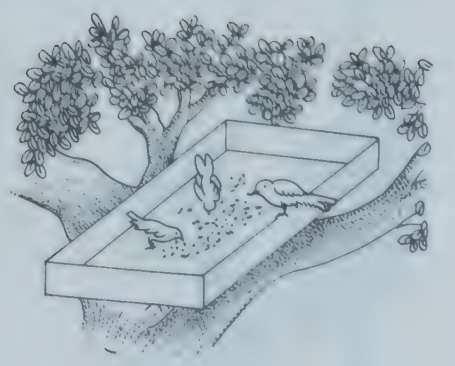
- Does the male or female make the nest? (either ask them to find out how to identify the male and female or tell them how to do it).
- What materials does the bird use to make the nest?
- Where does it bring these materials from?
- How many times in an hour does the bird come to the nest?
- How much time does the bird take to complete its nest?
- Can the students guess on which day the bird laid its eggs?
- How many days after the completion of the nest was the chirping of the baby birds heard?
- What is the difference between the baby bird's chirp and the parent bird's call?
- Who takes more care of the babies—the mother or the father?
- What do the parents feed the babies with?
- How many times in an hour do they feed the babies?
- Where do they get this food from?
- After how many days do the babies start flying?
- How do they learn to fly?
- Once they leave the nest, do the parents and babies come back to the nest?
- How long does it take, from the time the bird started building the nest, till the babies fly out of it?

Care should be taken not to disturb the nest while the eggs and babies are still there, as the parents may stop attending the nest if they spot anybody handling the nest. There is also the danger that the students themselves may accidentally topple the nest. This is a good time to emphasize the fact that in nature also, we should not disturb any nest or eggs as the birds may not return there to incubate the eggs.

Student should keep a record of bird activity near the nest box. The record should specify the species seen, time of the year, weather, nesting material, food taken to the box, number of fledglings, predatory attacks on the nest, etc. This constant observation will also help them to keep a check on any sort of vandalism Once the birds stop coming to the nest, the students can take out all the nesting materials and examine them

Once they have compiled this information, the students can let other students know about it, through posters. They could also keep informing the rest of the school about the developments as and when they take place.





Feeding Platforms

Students can take up a project to provide food and water to some of the local bird population.

The feeding platforms can be made in any open area which is not vulnerable to any predators, such as cats. It can be in the open stretch of ground in the school or in the balcony at home or on the terrace.

To construct a feeding platform, fix a flat tray over a stand. This can be done placing a flat piece of thick cardboard or plywood over a stand—any tree stump already present can also be used, otherwise a stand can be made out of wood and the tray fixed to it with the help of nails.

An old tin lid can be placed on the window ledge, or on a stand (like on a tree stump) and grains placed in it. Half of a used coconut-shell can be hung from a branch, with grains in it.

Investigating Food Preferences

For this the students should observe the common birds visiting the area and find out about their feeding habits. Then they can scatter different kinds of grains on the ground or window sill or any other suitable place where the birds can perch and feed. A bowl full of water can also be placed nearby. Students should make note of the following:

- Which birds visit the feeding area? What do they feed on?
- At what time of the day do they come?
- Are there any fights during feeding? Do they observe any hierarchy in feeding?

Grains of *jowar, bajra,* rice etc. can be used as feed. Soaked ground nuts, with shells, which are strung and hung near the window will also attract birds.

A quiet spot with relatively clear ground can also become a place where grain is regularly scattered. Gradually birds and squirrels will come to the spot, and become regular visitors.

Water can also be provided near to the feeding areas. Shallow earthen pots or water pots with their top broken, can be used to keep water for these. Avoid using vessels made of lead or copper for this purpose as they are poisonous.

Maintenance

These need little maintenance. The water should be replenished regularly and the container kept clean. The feed scattered should not be contaminated with chemicals and should not be rotting as it will affect the health of the animals which feed on it.

The students can, at the end of the project, share their findings with other students and teachers in the school.

Artificial Ponds

Water bodies, whether rivers or estuaries, mangroves or marshes, ponds or lakes, are home for a wide variety of birds and animals. Today many natural water bodies are under threat due to pollution, land filling, dams and drainage and irrigation schemes. This means a loss of habitat for innumerable living things.

If there is no natural water body nearby, students could take up a project to make and maintain an artificial pond near the school. This will develop into a mini wetland and provide a good opportunity to observe a variety of aquatic creatures and their interactions with their habitat.

Mini ponds can be made from old barrels, sinks, troughs, discarded wash basins and water tanks, which can be sunk into the ground. Copper or lead containers should not be used as they are poisonous.

An artificial pond can also be constructed in a small area in the school ground, or a vacant plot etc. depending upon the availability of space.

Site Selection

Before starting this project, a survey of the grounds/available place should be carried out to locate a suitable site. Points to be noted while deciding on the site for pond are:

- Is there a water supply from the land? Is it the ideal site for water catchment? (there should not be any flooding in case of heavy rains).
- Is it exposed to too much sunlight? (this might lead to more evaporation and excessive growth of algae).
- Is it visible, so that it is safe and can be watched for potential vandalism?
- Are any shady trees or those which shed their leaves, too close? (rotting leaves in the pond will reduce available oxygen).
- Is it close enough to a source of water for topping up when needed?
- Is it in a place likely to be used for something else (e.g. a building) in the near future?
- Are pipes, electricity and other cables well away from the excavations?

After selecting the site, it is important to get the permission of the concerned authorities, (the school principal, if it is inside the school grounds, the local authorities, municipality or the person who owns the place, etc.) to create a pond at the site.

Designing the Pond

Requirements: Rope, straight piece of wood, plastic liner.

The pond can be of any size, depending on the availability of space. The pond should at least have 90-120 cm of level ground around it.

The pond can be made out of concrete, pre-formed fibre glass, or puddled clay. In a school it is easy to use plastic, liner of PVC polythene or better still, butyl rubber. Scrap pieces of thick polythene can also be used but this degrades in sunlight and may wear out quickly.

- The outline of the pond should be marked by placing wooden pegs along the boundary.
- The top soil and sub soil dug up from that area should be kept in separate piles.
- The stones should be removed by hand and final leveling and shaping of the ground done using a spade.
- Ensure that at least one part of the pond is 75 to 100 cm deep, where temperature will not fluctuate too much (ensuring there will be cool water in extremes of heat).
- Provide a range of depths with gentle slopes to reduce slipping of substrate while making construction easier and the pond safer.
- Include planting of native plants around the pond as part of the design but be careful that their roots will not puncture the lining.
- Restrict access to perhaps two sides only, with hard-standing areas made with stones.

Installing the Liner

- Calculate the size of the liner needed. For this add two times the maximum depth to the length measured and the same to the width. (for e.g. if the length is 4 m, width 2 m and the depth is 1.5 m then the length of the liner should be 4 m+ (2 x 1.5 m) =7 m and the width should be 2 m+ (2 x 1.5 m) = 5 m).
- Some sand or old carpets should be put into the pit before the liner, to reduce the chances of stones puncturing it and matting added on top of the liner before adding the subsoil.
- If plastic liner is used, then its edges are to be tucked into the soil, so that it does not slip back into the dug up area. For this slits can be made into the soil profile in a few places to hold the edges of the liner and then it can be fixed by patting the soil.

Plants for the Pond

Bank side: Sedge, cotton grass, common fig wort

Shallow water plants: Common reed, water arum, horse-tail, water cress, typha

Floating water plants: Water lily, pond weed, arrow-head, duck weed, blanket weed

Underwater plants: Pond weed, stone wort, rush, tape grass, hydrilla.

- Then fill the pond with water, but wait for a few weeks for algal bloom to clear before native plants are introduced. A bucket of silt from another pond may be added to introduce a few invertebrates and microorganisms.

If invertebrates and amphibians have to thrive, fish should not be added. But to prevent mosquitoes from breeding, gambusia/ guppies/ other small cyprinid species—which will not eat the other invertebrates or amphibians can be introduced.

Maintenance

All ponds will naturally silt up with plant debris and the invasion of marginal vegetation. To prevent this, students should:

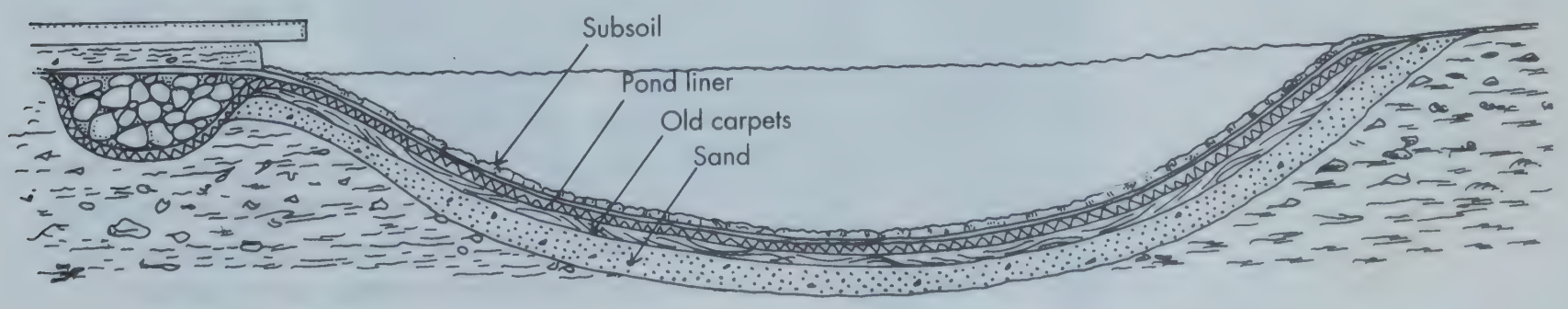
- Thin out the plants if they grow too vigorously. Students can use a long pole or stick with a sickle attached to it. They can also take the help of the school *mali* for doing this.
- Remove fallen leaves but leave them on the side of the pond, so that water animals can crawl back in.
- Twist the weeds on a stick and lift out.
- Replenish water in the pond in dry weather, ensuring that there are plenty of submerged oxygenating plants (this may help to inhibit any algal blooms encouraged by the nutrients in tap water).

The students should keep a record of the aquatic creatures insects, reptiles, amphibians, birds—they see in the pond and also on the edges of the pond. If possible they can observe microorganisms in the water with the help of a microscope or through a hand lens. They should also observe and keep records of other animals which come to the pond—whether they come in groups or singly, at what time of the day they come, etc.

The students can share their experiences with other students in the school. They can put up the drawings of the animals they have observed in the pond, with any other interesting details they might have come across. They can prepare a booklet with this information for the use by other students.

Beware

Care should be taken not to introduce some of the fast growing plants like water hyacinth, as this may spread through out the pond not allowing any other form to survive.



Some Bird Books

- The Book of Indian Birds
  Salim Ali
  Bombay Natural History Society, Mumbai
- What's that Bird?
  Kalpavriksha, New Delhi
- Some Indian Birds
  N.N. Majumdar
  Children's Book Trust
  New Delhi
- Our Feathered Friends
  U.C. Chopra
  Children's Book Trust
  New Delhi
- *Pakshi Nirikshan Pustika*
  (Hindi)
  CEE, Ahmedabad
- Common Birds
  Salim Ali, Laeeq Fatehally
  National Book Trust, India

Bird Counts

Students can do a project involving preparation of bird counts in different seasons. This project can be done in the neighbourhood of the school or home. It can also be carried out in the nearby area which has lot of trees or a waterbody. You can find out about any ongoing bird count project in the neighbourhood and see if your students can become a part of it. A local Nature Club could provide this kind of information and can help in listing common bird species of the area. Students should also be given an idea about the migration patterns of birds and the behavioural patterns of the birds in different seasons. The students can be introduced to some basic books on bird watching. If there is a local bird watcher to guide the observations, the experience will be enriched.

Requirements: A note book, pen, a bird book to help identification, binoculars.

The activity can be done by a group of students. The students should be advised to maintain silence while watching birds. The students should go to a spot/trail frequented by birds—a garden, neighbourhood park, a pond or some wetland, etc. The students should prepare an observation chart giving the following details:

No.	*Date and time*	*Common Name*	*No. of birds observed*	*Scientific Name*

The students can take an average of the readings they get over each month. They can also note at what time of the day the birds visit the area. At the end of the year's survey they can prepare a check list of birds and a compilation of the other data, e.g., the feeding habits of the various birds visiting this area, for use by nature clubs or other bird watchers in the area.

The students should prepare a map of the area based on their observations, indicating location of the trees, fields, water sources, etc. They can also find out how far the birds will have to go to feed, whether they make the nests near to the feeding areas or based on any other criteria? They can observe which birds roost or make nests in particular trees, or any other correlation.

This activity will help others involved in the conservation work—for example, if there is a decline in a particular species population, then they can cross check with the data collected by the students. This may give a clue about the reason for change in the bird population.

The students can also make posters with sketches or photographs of the birds, their description, where they were spotted and when, any interesting facts etc. and put them up on the notice board. In case they spot a new species, if possible they should try to get the details about the bird from some knowledgeable person or from books, and they can also inform the others through the bulletin board.

Outcomes

Through involvement in such projects, the students will become more aware of the flora and fauna around them. They will become sensitive to the different requirements of different animals and birds, in terms of their habitats, basic necessities etc. They can learn about the habits of various animals that visit these sites. The students will also learn about the role of these birds and animals in nature, such as in pest control, pollination, fertility of soil, etc. and they may try to use these very animals in pest control—biological control of pests. Above all, such projects will make students aware of the intricate linkages of all living things in the web of life and the importance of every creature—big or small— for life on earth. Once they get to know these animals intimately, the experience may change their attitudes, induce them to stop harming wildlife and start conserving it.

Play Detective

Trade in caged birds is an offence under the law. But such trade flourishes in many parts of the country. Students can check their local markets to see if such trade is taking place and report the same to TRAFFIC-India

TRAFFIC-India
Worldwide Fund for Nature
(WWF-India) Secretariat
172-B Lodi Estate
Max Mueller Marg
New Delhi-110 002

APPENDIX

Green Reading

Some Environment related magazines/newsletters

GREEN FILE

Monthly compilation of environmental newsclippings on India and South Asia with index, key words and summary.
Language: English Annual Subscription: Rs. 550/-

Centre for Science and Environment
41, Tughlakabad Institutional Area
New Delhi- 110 062

DOWN TO EARTH

A science and environment fortnightly of the Society for the Environmental Communications. Carries news, reviews, interviews, special reports on science and environment.
Language: English. Annual Subscription: Rs. 264/-

Society for Environmental Communications
41, Tughlakabad Institutional Area
New Delhi- 110 062

WWF - INDIA QUARTERLY

A newsletter of the World Wide Fund for Nature, India. Carries news, features, etc. on wildlife and nature.
Language: English. Annual Subscription: Rs. 100/-

Network Development
WWF - India, Post Box 3058
New Delhi- 110 003

HORNBILL

A quarterly magazine for children that carries conservation notes, news and comments.
Language: English. Annual Subscription & Membership fee: Rs. 1000/- for institutions, Rs. 75/- for student

Bombay Natural History Society, Hornbill House
Dr. Salim Ali Chowk, Shaheed Bhagat Singh Road
Mumbai- 400 023

SANCTUARY ASIA AND SANCTUARY CUB

Ecology and wildlife bimonthly magazines with articles and cover stories on environment and related issues. Cub is for children.
Language: English. Annual Subscription: Rs. 98/-

Sanctuary
602, Maker Chamber V, Nariman Point
Mumbai- 400 021

CEE - NFS

A monthly News and Feature Service from the Centre for Environment Education. Carries features on different aspects of nature, articles on environmental issues, interesting news, interviews etc. Language: English, Hindi, Kannada. Annual Subscriptions: Rs. 300/- for institutions, Rs. 150/-for voluntary organisations/individuals.

CEE- NFS
Centre for Environment Education
Thaltej Tekra,
Ahmedabad- 380 054

NEWS EE

A bimonthly newsletter for environmental educators, government agencies, NGOs, educational institutions etc. Carries information on the environment and about events, projects, experiments, innovations and developments in the field of environmental education.
Language: English. Annual Subscription: Rs. 50/-

Environmental Education Bank (EE Bank)
Centre for Environment Education
Thaltej Tekra,
Ahmedabad- 380 054

Basic reference books

Some references for those involved in environmental education and action.

Act Now
CEE, Ahmedabad

Book of Indian Reptiles, J. C. Daniel
Bombay Natural History Society, Mumbai

Common Fishes of India, B. F. Chhapgar
Oxford University Press, Delhi

Common Indian Snakes: A Field Guide, Romulus Whitaker
Macmillan Co. of India Ltd.

Common Trees of India, Pippa Mukherjee
Oxford University Press, Delhi

Diversity—The Corner Stone of Life, Madhav Gadgil
Bombay Natural History Society, Mumbai

Encyclopedia of India Natural History, R.E. Hawkins (ed.)
Bombay Natural History Society, Mumbai

Endangered Animals of India and Their Conservatin, S.M. Nair
National Book Trust, Delhi

Extinction is Forever, J.C. Daniel
Bombay Natural History Society, Mumbai

Field Guide to the Common Trees of India, P.V. Bole, Yogini Vaghani
WWF-I, Oxford University Press, Mumbai

Fishes, Mary Chandy
National Book Trust, New Delhi

Insects, M.S. Mani
National Book Trust, New Delhi

Moths of India, Issac Kehimkar
Bombay Natural History Society, Mumbai

Naturescope India: Amazing Mammals
CEE, Ahmedabad

Oceans Omnibus, Mamata Pandya, Meena Raghunathan
CEE, Ahmedabad

Our Feathered Friends, U.C. Chopra
Children's Book Trust, New Delhi

Our Land Our Life
Uttarakhand Paryavaran Shiksha Kendra, Almora

Pakshi Nirikshan Pustika (Hindi)
Centre for Environment Education, Ahmedabad

Predators and Prey, K.Ullas Karanth
Bombay Natural History Society, Mumbai

Some Indian Birds, N. Majumdar
Chidren's Book Trust, New Delhi

The Book of Indian Animals, S.H. Prater
Bombay Natural History Society, Mumbai

Some Beautiful Indian Trees, Ethelbert Blatter and W.S. Millard
Bombay Natural History Society, Mumbai.

The Book of Indian Birds, Salim Ali
Bombay Natural History Society, Mumbai

The Green Club
CEE, Ahmedabad

The Green Teacher
CEE, Ahmedabad

What's That Bird?
Kalpavriksh, New Delhi

Green Viewing

Given below are some sources from which slide-shows and video programmes on the environment may be bought or borrowed

1. Audio Visual Educational Resource Centre
   Dadar Woollen Mill Lane
   Kannada Mon. School
   R.K. Building, Taikalwadi Road
   Mahim, Mumbai- 400 016

2. World Wide Fund for Nature - India
   172 B, Lodi Estate
   New Delhi- 110 003

3. Alternative Communication Forum
   A-11, Green Park Extension
   New Delhi- 110 016

4. Sanctuary Films
   602, Maker Chamber
   Nariman Point
   Mumbai- 400 021

5. Tata Energy Research Institute(TERI)
   Darbari Seth Block
   Habitat Place, India Habitat Centre
   New Delhi- 110 003

The Television Trust for the Environment (TVE), is a non-profit organization promoting environment and development issues through broadcast television around the world.

TVE has a network of Video Resource Centres (VRC) in India, from where videos may be procured. They are :

1. Centre for Development of Instructional Technology (CENDIT)
   D-1, Soami Nagar
   New Delhi- 110 017

2. Centre for Environment Education
   Thaltej Tekra, Ahmedabad- 380 054

3. Centre for Science and Environment Audio-Visual Unit
   41,Tughlakabad Institutional Area
   New Delhi- 110 062

4. Development Alternatives
   B-32, Institutional Area,
   Tara Crescent
   New Mehrauli Road, New Delhi- 110 016

5. Trust Help
   A3,204, TTK Road
   Alwarpet
   Chennai- 600 018

Planning and Managing Green Projects: Some Tips

Before You Begin

- When you set objectives for your project, ensure that they are SMART, that is,
  - **Sensible**
  - **Measurable**
  - **Achievable**
  - **Realistic**
  - **Time-bound**
- Before starting out on the project, work out how much money you are likely to require. Some of the following heads may be relevant to put in:
  - Purchase of materials (e.g., gardening implements, saplings, craft materials, tool kit, film reel, etc.)
  - Travel and transport (e.g., for going to the project site if this is far from the school, for going to meetings—to the Municipal Office, Forest Department, etc.)
  - Resource persons (e.g., honorarium and local conveyance expenses may need to be paid to experts called in to deliver lectures, etc.)
  - Purchase of educational materials (e.g., reference books, video films, etc.)
  - Refreshments (e.g., when students stay late, some refreshments may have to be provided)
  - Communications (for letters, phone calls, etc.)

Think of where you are going to get the money from.

- Also make a list of the other resources you will require, e.g., an expert on vermiculture, access to a laboratory for water quality testing.
- The smooth conduct of the project will also be helped if a time and responsibilty chart is prepared and shared with all involved. The chart could have the following format:

Who will do what and how long it will take

Task	*Jul*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*
1. Survey of school electricity consumption	↔ Whole class							
2. Analysis of Results		↔ Group 1						
3. Preparation of Action Plan		↔ Whole class						
4. Meeting with the Principal			↔ Group 2					
5. Preparation for school Campaign			↔ Class Working in groups					
6. Implementation of School Campaign				↔ Whole class				
7. Report Preparation						↔ Group 3		
8. Review and Planning Meeting							↔ Whole class	

During the Project

- Monitor the progress of the project periodically—maybe once a month. Two easy ways would be to check whether the money is being spent as it should be, and whether activities are moving to satisfaction on the time-responsibility chart. Apart from this, each of the teams involved could give in a short written report each month.
- Co-ordination of the project would be facilitated by regular meetings where all those involved meet and discuss progress, problems, etc. Planning for forthcoming events could be done, as well as any changes, if required in the project strategy.

After the Project

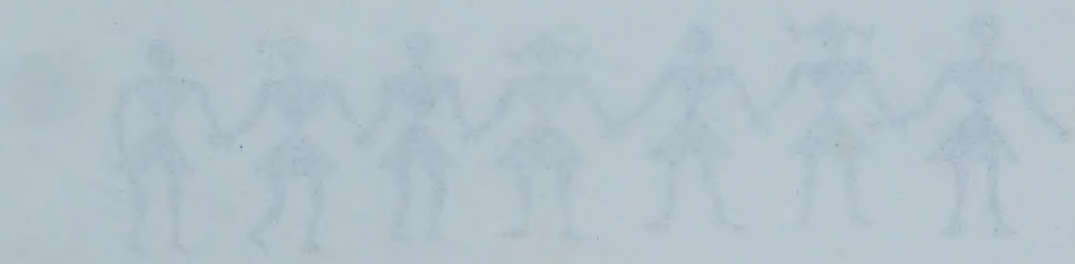
- Ensure that a complete report is prepared. The report should include not only what was done and how it was done, but also a discussion on problems encountered, challenges faced, learnings, and an analysis of why things went as they did, and how they could be improved upon. The report should be made interesting and may include photographs, illustrations, anecdotes, etc.
- Prepare the accounts. You can use any format that is convenient, but make sure that it clearly indicates where the money came from and how it was spent. A sample format is given below.

Account Format

Particulars	*Debit*	*Credit*	*Balance*
1. Conveyance			
2. Resource person honorarium			
3. Refreshment			
4. Stationary			
5. Research and Documentation			
6. Preparation of Communication Material			
7. Administrative Expenses			

Note: Under Credit: Mention the source of income, such as registration fees, money received from any outside agency.
Under Debit: Mention the expenses incurred under each head.
Balance: Credit minus Debit

- Inform the various people involved in the project at various stages about the outcomes, and thank them for their inputs. This list may include the school principal, the school staff and students, community, government officials, experts, etc.
- And start planning on how to build on this environmental improvement project to undertake another one.....



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RETURN DATE SLIP

DUE DATE	DUE DATE	DUE DATE

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